BRYOZOA FROM THE LOWER CARBONIFEROUS OF NEW SOUTH WALES AND QUEENSLAND.

By Joan Crockford, M.Sc.*

(Plates i–vi; fifty-one Text-figures.)

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Introduction.

Bryozoa from widely separated areas in which marine Lower Carboniferous strata occur in eastern Australia are described in this paper; the specimens described in Part i are from the Lion Creek Limestone near Stanwell, from two horizons in the Viséan near Mundubbera, and from Cannindah in southern Queensland, and those described in Part ii are from the marine Burindi Series and also from a marine intercalation in the freshwater Lower Kuttung Series which overlies it in the Clarencetown–Paterson–Rouchel Brook district to the north of the Hunter River and from the Upper Burindi Series at Taree in New South Wales. The faunas so far known (they are probably far from complete) in these areas contain the largest and best preserved series of Bryozoa at present known from the Lower Carboniferous in eastern Australia; Bryozoa occur at many other localities from which very little collecting has so far been done, and it is certain that in time the number of genera and species described from the Lower Carboniferous here will be vastly increased.

Although many records of the occurrence of Bryozoa in rocks which are, or may be, of Lower Carboniferous age in both New South Wales and Queensland have hitherto been made, only a few of these records are accompanied by descriptions or by figures, and the localities from which they have been collected are usually not at all precisely recorded. The more important of these previous records are discussed in this paper.

Both in New South Wales and in Queensland, despite the comparatively small number of species so far described, the cosmopolitan nature of the Lower Carboniferous bryozoan faunas compared with the limited number of families and genera present in the Permian is very striking. The Permian throughout eastern Australia contains enormous numbers of fenestellids and stenoporids, but Bryozoa belonging to other families are extremely rare, although a few Rhabdomesontidae and Acanthocladiidae do occur. In the Lower Carboniferous, on the other hand, although fenestellids are abundant, stenoporids are virtually absent—the earliest definitely known stenoporid in Australia is a specimen from the Upper Viséan Lion Creek Limestone at Stanwell; but many other bryozoan genera, belonging to the Fistuliporidae, Sulcoreteporidae, Rhabdomesontidae and Acanthocladiidae, are well represented; the cosmopolitan nature of the fauna is strongly emphasized by the occurrence here of specialized and comparatively rare genera, such as *Evactinopora*, *Archimedes*, *Goniocladia* and *Ramipora*, particularly as these first appear in Australia upon an horizon approximately equivalent to that in which they first occur in other parts of the world.

The stratigraphic significance of these Bryozoa and the relationship of these Lower Carboniferous faunas to those occurring in later Upper Palaeozoic rocks in Australia are to be discussed in detail in a later paper.

Dr. Dorothy Hill and Dr. F. W. Whitehouse of the University of Queensland kindly lent me specimens from Mundubbera which contain Bryozoa previously exhibited by Dr. Whitehouse at a meeting of the Royal Society of Queensland; specimens which Mr. R. Etheridge, jnr., described from the Lion Creek limestone at Stanwell were lent to me from the Australian Museum Collections. I am indebted to Dr. G. D. Osborne for many

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specimens of Bryozoa which he has collected for me from the Burindi and Lower Kuttung Series in the northern Hunter River district. Dr. Ida Brown has also collected a number of specimens for me from more northerly outcrops of the Burindi Series, and has been generous with her helpful criticism during the writing of this paper.

Part I. Lower Carboniferous Bryozoa from Queensland.

Fossiliferous marine strata of Lower Carboniferous age outcrop at a large number of localities in Queensland, but there are very few records of the occurrence of Bryozoa in rocks which are of undoubted Lower Carboniferous age. This is partly due to the fact that most of the localities given in early descriptions and lists of fossils were very generalized, and even the approximate horizon from which the fossils were collected is made uncertain by the presence in the same general area of Devonian or of Upper Carboniferous or Permian fossiliferous rocks. The older records, therefore, are of little value, with the exception of the interesting record by Etheridge (1900, 8) of the occurrence of "*Fistulipora* or *Hexagonella*" and "*Stenopora Leichardtii*" from the Oolitic Limestone of Lion Creek, Stanwell, near Rockhampton; these specimens, now in the Australian Museum Collection, are re-described in this paper; Etheridge's paper is of particular interest in that it records the earliest stenoporid so far known with certainty to occur in Australia.

In 1929 Dr. F. W. Whitehouse exhibited at a meeting of the Royal Society of Queensland specimens of *Archimedes* and *Evactinopora* collected from strata of Viséan age near Mundubbera in Queensland. The two specimens of *Archimedes* were collected from the Riverleigh Limestone, the age of which has been determined from the coral fauna [described in detail by Hill (1934, 105; 1943, 62)] to be Upper Viséan or possibly slightly younger. The specimen of *Evactinopora* was collected from an oolitic limestone horizon in the same district; this limestone, which contains *Palaeacis* sp. cf. *cuneiformis* Haime (Hill, 1934, 101) is probably slightly younger in age than the Riverleigh limestone. The fossils contained in all of these specimens were silicified, and when they were etched, specimens of a number of other interesting species of Bryozoa were found to be contained in them; these forms, as well as the species of *Archimedes* and *Evactinopora*, are described in this paper.

Specimens of limestone which Professor S. W. Carey collected from the Lower Carboniferous limestones at Canindah, to the south of Mundubbera (6448, Sydney Univ. Colln.), also contain silicified fistuliporoids.

No Bryozoa from the younger Carboniferous rocks of Queensland are described in this paper, but they form an abundant part of the fauna of the Neerkol Series of Upper Carboniferous age in the type locality for this Series, near Rockhampton, and in other districts.

The full localities from which the Lower Carboniferous Bryozoa from Queensland described in this paper were collected are as follows:

Cannindah: A crinoidal limestone horizon, Old Cannindah Homestead, near Monto, Queensland (= loc. "a" of Hill, 1934, 106).

Lion Creek Limestone: Oolitic Limestone horizon in Lion Creek, Stanwell, near Rockhampton.

Oolitic Limestone, Par. Mundowran: Oolitic Limestone horizon in Por. 193, Par. Mundowran, Co. Yarrol, near Mundubbera.

Riverleigh Limestone: Latza's Farm, Pors. 21 and 22, Par. Malmoe, Co. Yarrol, near Mundubbera.

The coral faunas of these limestone horizons have been described and their stratigraphic position discussed by Hill (1934, 1943) and work on them summarized also by Bryan and Jones (1944).

Description of Species.

Order Cyclostomata Busk.

Family Fistuliporidae Ulrich.

Fistuliporidae Ulrich, 1882; Cheilotrypidae Moore and Dudley, 1944, 255.

Nomenclature of this family and of several genera within it has been discussed at length by Moore and Dudley; they consider the generic name *Fistulipora* M'Coy a homonym and the name Fistuliporidae therefore not available for this family; they propose to substitute the name Cheilotrypidae (type genus: *Cheilotrypa* Ulrich, 1884).

According to Moore and Dudley, *Fistulipora* M'Coy, 1850, is a homonym of *Fistulipora* Rafinesque, 1831, the name having been used by Rafinesque for an unrecognizable Palaeozoic fossil; this genus, despite the fact that it cannot now be identified, was, as Moore and Dudley point out, validly designated, and should therefore, provided the name was published by Rafinesque prior to M'Coy's paper in 1850, render *Fistulipora* M'Coy a homonym. Whether Rafinesque actually did publish this name prior to 1850, however, seems to be open to question; Moore and Dudley state (p. 253) that "Rafinesque (1831, p. 5) published *Fistulipora* as the name of a Paleozoic fossil from Kentucky, antedating McCoy's paper by some 18 years", but in their bibliography (p. 310) the reference to this paper is given as follows:

"Rafinesque, C. S., *1831*, Description of fossils in cabinet, pp. 1–5, Philadelphia (private publication)."

I have been unable to find any other reference to this paper by Rafinesque, and I am therefore in no position to discuss fully the status of this publication. If, however, this reference is to a descriptive catalogue of a similar type to a museum catalogue and was not actually published by Rafinesque in 1831, in the sense in which the term "publication" may be interpreted in the Rules of Nomenclature (cf., discussion of this term by Stiles, 1928, 571–578), as seems to me rather probable from the manner in which Moore and Dudley refer to this paper as a "private publication", *Fistulipora* Rafinesque would rank as a manuscript name, and when published *fide* Rafinesque by a later author should take the date of this later reference, this being the date of actual publication of the name; in this case, the date of publication of *Fistulipora* Rafinesque should be either 1864, in which year Binney and Tryon published a work entitled "The complete works of Constantin Smaltz Rafinesque" in which I presume this 1831 paper would have been included (Binney and Tryon's paper is not available to me), or else 1944, when Moore and Dudley reprinted Rafinesque's definition of this name. In either of these cases, *Fistulipora* M'Coy, 1850, would have clear priority over *Fistulipora* Rafinesque.

This interpretation of the question, under which *Fistulipora* M'Coy is considered to be a valid name, is followed here, and the name Fistuliporidae is therefore used for the family.

Three sub-families within the Fistuliporidae are recognized in this paper. As is more fully discussed after the diagnoses of the sub-families Hexagonellinae, n. sub-fam., and Goniocladiinae Waagen and Pichl, it is here considered that a number of genera previously referred to the Sulcoreteporidae are essentially fistuliporoid in their internal structure; the absence of structures diagnostic of *Sulcoretepora* and closely related genera in their internal structure serves clearly to differentiate these genera from true Sulcoreteporidae, which in some cases they fairly closely resemble externally. These genera therefore appear more logically referred to the Fistuliporidae than to the Sulcoreteporidae, and are here placed in two sub-families within this family; typical Fistuliporidae are therefore referred to a third sub-family, the sub-family Fistuliporinae Waagen and Wentzel.

Sub-family FISTULIPORINAE Waagen and Wentzel, 1886 (emend.).

Fistuliporinae Waagen and Wentzel, 1886, 909.

Typical Fistuliporidae, with massive, laminar, encrusting, or ramose zoaria; surface with monticules or maculae; zooecial tubes usually with well-developed lunaria, and with or without diaphragms; tubes separated by vesicular tissue, which is sometimes separated by dense tissue as the surface is approached.

This sub-family was originally proposed by Waagen and Wentzel in their monograph on the Salt Range Fossils to include two of the genera with which they were dealing, *Fistulipora* M'Coy and *Dybowskiella* Waagen and Wentzel. It is regarded in this paper as including all the genera of Fistuliporidae which are not referred to the sub-families Hexagonellinae, n. sub-fam., and Goniocladiinae Waagen and Pichl, and therefore to include all the genera listed as belonging to the Fistuliporidae by Bassler in 1935 (p. 16) except *Hexagonella* Waagen and Wentzel and *Meekopora* Ulrich.

Genus FISTULIPORA M'Coy, 1850.

Fistulipora M'Coy, 1850, 131; *Fistulipora* M'Coy, Ulrich, 1890, 382, 474; *Fistulipora* (pars) M'Coy, Bassler, 1929, 41; Crockford, 1944, 143. [non] *Fistulipora* Rafinesque, Moore and Dudley, 1944, 253.

Zoarium incrusting to massive or ramose, surface with monticules or maculae composed of aggregations of vesicles or of enlarged zooecia; zooecial tubes with inconspicuous or faint lunaria, or with thickened lunaria the ends of which do not indent the zooecial tubes; diaphragms usually developed; interzooecial spaces occupied by vesicular tissue which is sometimes replaced by dense tissue near the surface.

Genotype: *Fistulipora minor* M'Coy, 1850.

Range: Ordovician to Permian.

The status of this generic name has been referred to in discussion of the naming of the family Fistuliporidae (pp. 2–3), and it has been pointed out that, since the paper in which Rafinesque proposed the generic name *Fistulipora* for an unknown Palaeozoic fossil was a private publication, and the name does not appear to have been actually published prior to 1850, *Fistulipora* M'Coy, 1850, appears to be the valid name for this genus of bryozoans.

The generic name *Fistulipora* has until recently been used to include incrusting, massive and ramose zoaria with typical fistuliporoid internal structure, irrespective of the degree of development of the lunaria. From recent work, and especially from that of Moore and Dudley (1944), it appears that subdivision of the genus upon the basis of lunarial development is possible and will become essential as work on this group progresses. *Fistulipora* ranges from the early Ordovician to the Permian, and within the many species grouped under this name great variation in the size, thickening, and degree of development of the lunarium is found. Moore and Dudley, working upon the assumption that *Fistulipora* was not a valid name, considered that *Cyclotrypa* Ulrich, 1896, proposed for species in which lunaria are absent or inconspicuous, should be used for species in which the lunaria are poorly developed. The genotype of *Fistulipora*, *F. minor* M'Coy, 1850 (? = *Calamopora incrustans* Phillips), is in need of revision from type or topotype material, but appears from M'Coy's original illustrations to have been a species in which the lunarium was either poorly developed or almost absent, and species which have been closely compared with this form by later workers upon Carboniferous material from the British Isles have always been species in which the lunaria are inconspicuous. *Fistulipora minor* at present therefore appears to belong to the group for which *Cyclotrypa* was later proposed, and *Cyclotrypa* must therefore be considered a synonym of *Fistulipora*, unless a re-examination of the type of *F. minor* or of topotype material shows differences between them.

One group of species common in Upper Palaeozoic rocks is differentiated from *F. minor* and closely-related species by the possession of very strong lunaria, the ends of which indent the zooecial tubes so that they are bilobate or trilobate in transverse section; these forms are referred to *Dybowskiella* Waagen and Wentzel, 1886. There are many species, however, in which the lunaria are strongly thickened but do not at all project into the zooecial tubes, which lack the strongly-marked lobed appearance of the tubes of *Dybowskiella*. Many of the species of *Fistulipora* which have been described from the Permian of Timor and of Western Australia belong to this group; these seem at present best still referred to *Fistulipora*.

As well as these differences in the degree of development of the lunarium, many species both of *Fistulipora* and of *Dybowskiella*, and particularly late Palaeozoic forms, show progressive replacement of the vesicular tissue near the surface by dense tissue; this characteristic, which appears to be of specific and not of generic value, is found in several of the fistuliporoids in the Western Australian Permian, and occurs to a slight degree in both of the species of *Dybowskiella* described in this paper.

FISTULIPORA ETHERIDGEI, n. sp. Text-figs. 1, 2.

Fistulipora or *Hexagonella*, Etheridge, 1900, 8.

Holotype: F.6856C, Australian Museum Colln.

Horizon and locality: Lion Creek Oolitic Limestone, Stanwell, near Rockhampton.

Laminar Fistulipora; *zooecial tubes very slightly indented by thin lunaria; diaphragms numerous and closely spaced; tubes separated by coarse vesicular tissue.*

The zoaria consist of thin sub-circular laminar expansions up to 10 mm., but usually about 3 mm. in their greatest thickness and 2·5 cm. or more in diameter; individual colonies are frequently built up, especially in the case of the thicker zoaria, by thin discontinuous laminae; Etheridge commented upon this lamination and considered it a possibility that the zoaria were bifoliate, but the direction of growth of the zooecia shows clearly that these are successive laminae and not the two sides of a bifoliate colony. The base of the colony was covered by an undulating and concentrically wrinkled epitheca, shown very well on the etched under surface of one of the colonies; the upper surface of the zoarium is irregular but is more or less flattened. Small slightly depressed spot-like maculae about 1·5 to 2 mm. in diameter are developed on the upper surface 3·5 to 5 mm. apart; these maculae are composed of aggregations of vesicular tissue, but their surface, like the surface between the apertures, appears solid except where it has been weathered sufficiently to reveal the vesicles.

The zooecia are tubular; their apertures are almost imperceptibly indented by the development of slight lunaria, which extend around rather more than one-quarter of the circumference of each tube; these lunaria are a little raised at the surface. The tubes are usually from 0·19 to 0·24 mm. in diameter, but some of the tubes adjacent to maculae are considerably larger, up to 0·32 mm. in diameter; the lunaria are inconspicuous and unthickened in sections, and do not show out as well as they do on etched surfaces. The zooecia are prostrate for a very short distance along the basal epitheca and then bend upwards to the surface. Numerous thin, slightly concave, complete diaphragms are developed in the zooecial tubes; as many as seven or eight of these diaphragms may occur in 1 mm., but the tubes are usually without diaphragms for a short distance from the surface, about 0·5 to 0·9 mm., though occasionally diaphragms are developed almost until the surface is reached; in some cases where the laminae are very thin, less than 1 mm. in thickness, no diaphragms have been developed in some of the zooecial tubes. The zooecia are separated by rather coarse vesicular tissue, a single row of which usually occurs between adjacent zooecia. A very thin layer of dense tissue was developed at the surface. In 7 sq. mm., excluding maculae, there are about 30 zooecial tubes.

Etheridge hesitated between the generic names *Hexagonella* and *Fistulipora* for this species, as he considered it possible that the zoarium might have been bifoliate; however, the zoaria are composed of successive laminae growing in the same direction and not of two laminae growing together back to back, and therefore the species cannot be referred to *Hexagonella*. The thin laminar growth form, the poorly-developed lunaria, and the coarse vesicular tissue readily serve to distinguish this species.

Genus DYBOWSKIELLA Waagen and Wentzel, 1886.

Dybowskiella Waagen and Wentzel, 1886, 910, 916. Synonym: *Triphyllotrypa* Moore and Dudley, 1944, 260, 291.

Zoaria laminar, massive, lobate or coarsely ramose, with fistuliporoid internal structure but differing from Fistulipora *in possessing very strongly-developed lunaria, the ends of which project into the zooecial tubes, which are therefore bilobate or trilobate in transverse section; typically the projecting ends of the lunaria form longitudinal ridges, termed pseudosepta, within the zooecial tubes.*

Genotype: *Dybowskiella grandis* Waagen and Wentzel, 1886 (as lectotype of this species, of which a number of specimens from different localities was originally figured without selection of a holotype, the specimen figured by Waagen and Wentzel, 1886, on Pl. civ, figs. 2*a* and 2*b*, is here selected; the locality of this specimen is Upper Productus Limestone, from the mountains east of Katwáhi).

Range: Devonian to Permian.

Moore and Dudley considered that the genotype of *Dybowskiella* possessed a hollow ramose zoarium, and they therefore proposed the genus *Triphyllotrypa* for species with similar internal structure but with laminar, massive or lobate zoaria. Waagen and Wentzel (1886, Pls. cii, ciii, civ, figs. 1–4, 7; cvi, fig. 7; cxv, fig. 6) published numerous figures of *Dybowskiella grandis*, the genotype of *Dybowskiella*, and while a number of these shows ramose branches with an irregular central cavity which they attributed partly to the zoarium having incrusted some irregular soft body or to worm borings, and whose marked irregularity does not suggest close comparison with the central tubes shown in *Coelocaulis*, *Cheilotrypa* and *Rhabdomeson*, two illustrations (Pl. civ, fig. 2*b*, and Pl. cvi, fig. 7) show ramose branches which are solid and have no suggestion of a central cavity. In other specimens, which Waagen and Wentzel figure, the central cavity may be fortuitous and due to breaking down of the looser tissue of the central part of the branch so that the central part of the zoarium was later filled by sediment, an irregularity of preservation frequently found in the central part of a coarse ramose bryozoan colony. The specimen illustrated by Waagen and Wentzel, and here selected as lectotype, of *Dybowskiella grandis* possesses a solid ramose zoarium.

Triphyllotrypa Moore and Dudley differs from *Dybowskiella* only in the form of its zoarium, this being a laminar expansion in the type of *Triphyllotrypa* and laminar, massive, and in one case lobate, in other species referred to this genus. The zoarial difference alone between incrusting, laminar, massive and solid ramose growth forms in the fistuliporoids does not appear to be a character of generic significance; the zoarial form of many species, such as *Triphyllotrypa spissa* Moore and Dudley, where the upper surface of an incrusting zoarium "bears local upward projections, one of them 16 mm. high", provides evidence of gradation between these different types of zoaria. No structural internal differences exist between *Dybowskiella* and *Triphyllotrypa*. It is here considered therefore that *Triphyllotrypa* must be regarded as a synonym of *Dybowskiella*.

No structures which could serve to differentiate generically the two Lower Carboniferous species described in this paper from Queensland and New South Wales from Permian species described by Waagen and Wentzel and by Moore and Dudley or from species from the Permian of Timor, Western Australia and the Northern Territory, which should be referred to this genus, could be found. Prominent trilobate zooecia are found also in some Devonian species, e.g., *Fistulipora foordi* Ulrich, 1890, and *F. triloba* Hall and Simpson, 1887.

Dybowskiella crescentica, n. sp. Text-fig. 3.

Holotype: 6448, Sydney Univ. Colln.

Horizon and locality: Crinoidal Limestone, Old Cannindah Homestead, near Monto, Queensland.

Incrusting Dybowskiella; *zoarium thin, zooecial tubes with pronounced lunaria, the ends of which are projecting; tubes short, usually without diaphragms, and separated by coarse vesicular tissue.*

The zoarium is incrusting; it is thin, usually about 0·08 to 1 mm. but sometimes slightly more in thickness; the holotype encrusts a thick crinoid stem and from one side of it a hollow spherical outgrowth, apparently originally encrusting, but whose support is now worn away, is shown in thin section. A thin epitheca is developed on the lower side of the zoarium; on the upper surface spot-like raised maculae about 1 mm. in diameter and 4 mm. apart are developed; these maculae are composed of aggregations of vesicular tissue. Each zooecial aperture is placed in the centre of a polygonal depressed area, the junction of the edges of these areas forming prominent polygonal ridges on the surface; the apertures are strongly indented by lunaria, but these lunaria are only slightly raised at the surface.

The zooecial tubes are short, being horizontal for a short distance and then bending outwards sharply to the surface. They are strongly indented by thick horse-shoe shaped lunaria, which extend around about one-half of the circumference of each tube; the measurements of the tubes are: *a*, 0·24 to 0·29 mm.; *b*, 0·22 to 0·27 mm.; *c*, 0·14 to

0·19 mm.; *d*, 0·15 to 0·19 mm.* The lunaria are considerably thickened and are very prominent in sections. An occasional diaphragm is developed in some of the zooecial tubes, but most of the tubes are without diaphragms. The zooecia are separated by rather flattened coarse vesicles, two rows of which are usually developed between adjacent zooecia; in some places these vesicles are noticeably thick walled and have become partially replaced by dense tissue. There were about 26 zooecia in 7 sq. mm.

The form of the zoarium, raised maculae, and very prominent lunaria readily serve to distinguish this species from *Fistulipora etheridgei*, n. sp.

Sub-family HEXAGONELLINAE, n. sub-fam.

Zoaria bifoliate, consisting of two or more layers of zooecia grown together back to back; where three or more layers of zooecia are developed vertical-rayed growth-forms are formed; margins of the zoarium sharp or rounded, and with a narrow non-poriferous border; surface, except where the zoarium is very narrow, with non-celluliferous maculae, characteristic for each species in their size, shape and spacing; fine ridges which divide the surface into areas of characteristic size and shape also developed in many species. Zooecia tubular, lying parallel to the mesial lamina for some distance, usually about one-third their length or less, then bending fairly rapidly upwards to meet the surface almost perpendicularly. Tubes rounded, not angular, in cross-section, and with lunaria poorly developed or absent; without hemisepta, but frequently with complete diaphragms. Mesial lamina with fine median tubuli. Zooecia separated internally by vesicular tissue, and never arranged between vertical double plates; vesicles replaced by dense tissue as the surface is approached.

Range: Mississippian to Permian.

The genera which are here considered to belong to this sub-family are:

Coscinium Keyserling, 1846; *Evactinopora* Meek and Worthen, 1865; *Glyptopora* Ulrich, 1884; *Hexagonella* Waagen and Wentzel, 1886; *Meekopora* Ulrich, 1889; *Meekoporella* Moore and Dudley, 1944; *Prismopora* Hall, 1883; and *Fistulamina*, n. gen.

Other genera, such as *Scalaripora* Hall, 1883, may also possess the same type of internal structure as *Hexagonella*, and if so, should be referred here.

The sub-family Hexagonellinae includes genera which, with the exception of *Hexagonella*, *Meekopora* and *Meekoporella*, have previously been referred to the family Sulcoreteporidae Bassler (= Cystodictyonidae Ulrich), but do not show the internal structure characteristic of *Sulcoretepora*. *Sulcoretepora* itself and a number of genera closely related to it show a specialized type of internal structure, the zooecia on each side of the mesial lamina being arranged in rows between longitudinal vertical plates, and the zooecia are rather short, semi-cordate in outline and sharply geniculate, with well-developed hemisepta. These genera are typical members of the Cryptostomata. Other genera previously referred to the family, however, show fistuliporoid internal structure, identical with the type of internal structure found in *Hexagonella*; *Hexagonella* differs from *Fistulipora* principally in the bifoliate form of its zoaria, and also in the typically weak development or absence of lunaria. As a group, the genera here referred to the Hexagonellinae are also characterized by rather more strongly geniculate zooecia than those of typical fistuliporoids.

It has long been recognized that close similarity exists between some genera referred to the Sulcoreteporidae and the Fistuliporidae; indeed, Ulrich, in his original discussion of the family Sulcoreteporidae (as Cystodictyonidae Ulrich, 1885, 35), pointed out the close relationship of the group of genera which he included in this family to the Fistuliporidae, stating that they differed from it "mainly in possessing two or more leaved zoaria, the margins of which are non-poriferous and usually sharp". In spite of this long recognized relationship, these genera have been classified in different orders, those placed in the Fistuliporidae in the Cyclostomata, and those placed in the Sulcoreteporidae in the Cryptostomata. Had the genera in which this close relationship is shown been of early Palaeozoic age, their classification into different orders might perhaps be accounted for as the result of imperfect differentiation of two separate

* Measured as previously explained (Crockford, 1944, 142, Text-fig. C).

phylogenetic groups at an early stage of their evolution, but with Bryozoa of Carboniferous to Permian age it should be possible readily to differentiate between genera of two orders which were distinct in the early part of the Ordovician. It is here considered that such differentiation can be clearly and easily made if the Sulcoreteporidae are restricted to genera showing the very specialized type of cryptostomatous internal structure shown in *Sulcoretepora*, and the genera with fistuliporoid internal structure which constitute the remainder of this family as hitherto defined are removed and classified with *Hexagonella.*

Since bifoliate zoaria are developed in such a large group of genera with fistuliporoid internal structure, and these bifoliate zoaria are elaborated into so many diverse and specialized growth-forms, such as those found in *Evactinopora*, *Coscinium* and *Glyptopora*, it is here considered that they form a compact and phylogenetically related group within the Fistuliporidae which should be classified as a separate sub-family.

Genus Evactinopora Meek and Worthen, 1865.

Evactinopora Meek and Worthen, 1865, 165; *Evactinopora* Meek and Worthen, Ulrich, 1884, 42; Ulrich, 1890, 387, 508.

Zoarium free, consisting of three or more bifoliate vertical leaves, radiating from an imaginary axis so as to present a star-shaped outline in transverse section; zooecia and internal structure as in Hexagonella.

Genotype: *Evactinopora radiata* Meek and Worthen, 1865.

Range: Mississippian to Permian.

Evactinopora irregularis, n. sp. Pl. i, figs. 3–6; Text-figs. 4–6.

Evactinopora, Whitehouse, 1929, xii; Hill, 1934, 105.

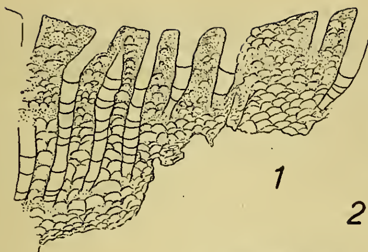
Holotype: F.5769A, Univ. Queensland Colln.

Horizon and locality: Oolitic Limestone, Por. 193, Par. Mundowran.

Four-rayed Evactinopora; *rays bifoliate, thin, broad, leaf-like; surface with small, solid, regularly placed maculae; zooecia placed back to back along the mesial lamina in the centre of each branch, where they are separated by fine vesicular tissue, and then bending rapidly outwards to meet the surface at right angles, being separated in the outer part of the zoarium by dense tissue.*

The zoarium is bifoliate, the growth-form being four-rayed; the holotype is a broken specimen, and is now 5·5 cm. high and about 5 cm. in its greatest diameter, neither of these measurements being the full extent of the perfect zoarium. The rays intersect at the base of the zoarium at about 80° to 85°, one of the rays being curved and the others more or less straight; at the upper end, however, two of the rays have curved away from each other, the zoarium here being shaped like a bent H (Pl. i, fig. 4). The best preserved ray reaches a maximum width of 3·7 cm., its outer edge being blunt and rounded. Small, solid, slightly depressed maculae are prominent on the surface of the rays; the maculae are elongated, 2·8 to 4 mm. long and about 1 mm. wide, and they are arranged rather regularly in close-spaced rows radiating gradually from the base of the colony; these rows of maculae are usually almost vertical near the centre of the zoarium, and curve outwards obliquely near the edges of the rays, but on one of the rays all of the rows of maculae are oblique; the centres of the maculae are usually placed from 4·5 to 7 mm. apart. The zooecial apertures are small, and are rounded to slightly oval, 0·16 to 0·22 × 0·16 mm. in diameter; they are slightly indented by the lunaria, which, when well preserved, are raised and hood-like at the surface; the apertures show up clearly on the etched and weathered surface of the zoarium, the tissue between them being solid at the surface. On the broken edges of the rays the mesial lamina and longitudinal sections of the zooecial tubes can also be seen very clearly.

The zooecia are tubular; they arise on each side of a distinct mesial lamina, along which they are horizontal for a short distance (up to 0·7 mm.) and then curve rapidly upwards to meet the surface at about 75° to 90°. In transverse section the tubes are rounded, or they may be a little indented by a slight lunarium where the tube wall is curved to a slightly shorter radius around about one-third of the circumference of the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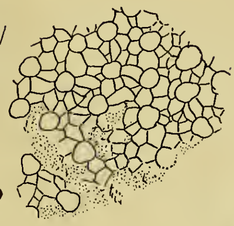
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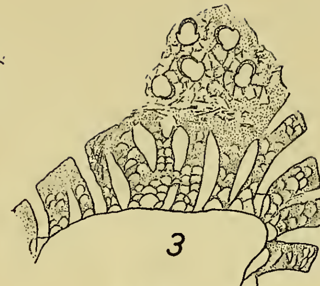
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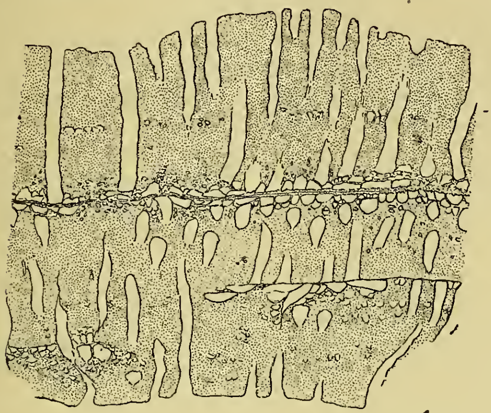
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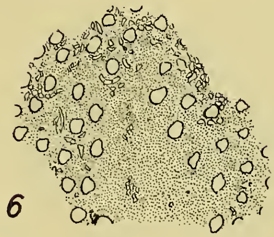
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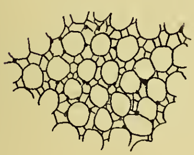
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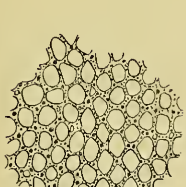
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Text-figs. 1-2.—*Fistulipora etheridgei*, n. sp., × 10. 1. Vertical section of the holotype. 2. Tangential section of a second specimen in the same piece of limestone. (Slides 131A-D, Australian Museum Colln.)

Text-fig. 3.—*Dybowskiella crescentica*, n sp., × 10. Oblique section of the holotype.

Text-figs. 4-6.—*Evactinopora irregularis*, n. sp., × 10. 4. Vertical section through one ray of the holotype. 5. Tangential section through a ray of the holotype, the section being cut adjacent to the mesial lamina upon which the zooecial tubes are recumbent for a short distance before they bend upwards to the surface. 6. Tangential section cut close to the surface of the holotype.

Text-figs. 7-8.—*Leioclema porosa*, n. sp., × 10. 7. Tangential section of the holotype. 8. Vertical section of a second specimen in the same piece of limestone. (Slides 131A-D, Australian Museum Colln.)

Text-figs. 9-10.—*Stenodiscus stanwellensis*, n. sp., × 10. 9. Tangential section of the holotype. 10. Vertical section of a second specimen in the same piece of limestone. (Slides 131A-D, Australian Museum Colln.)

tube; the silicification of the specimen has made these lunaria rather difficult to observe, but they are shown quite clearly in some of the tubes by slight thickening of the tube wall, and by their different curvature. In the central part of the zoarium the tubes are separated by small vesicles, but these are rapidly replaced by dense tissue, with only occasional vesicles, as the tubes bend upwards to the surface; where the growth of the zoarium has been interrupted and rejuvenation has occurred, narrow zones of these vesicles are found closer to the surface, in places associated with rejuvenated zooecial tubes. No diaphragms and no hemisepta occur in the tubes, and acanthopores are not developed. Ulrich (1884, 42) stresses the degree to which the apertures in the early part of the zoarium have been infilled and the zoarium itself thickened by calcareous tissue in *E. radiata*; although the lower part of the zoarium has been thickened by overgrowths of vesicles and dense tissue and by rejuvenation of the zooecia in this specimen of *E. irregularis*, the apertures are not infilled by the dense tissue to any marked degree; the base of the specimen as it is now preserved appears to have been slightly spreading, and this may perhaps indicate that this species was lightly attached at the base, as was *E. trifoliata*, n. sp., from the Burindi Series in New South Wales; as a free zoarium would have evolved from an attached form, this suggests that both of these Australian Lower Carboniferous species are slightly more primitive forms than any species of *Evactinopora* hitherto described.

This species of *Evactinopora* is clearly differentiated in the details of its external structure from the five described species of this genus, four of which come from the Mississippian of the United States, and one, *E. crucialis* Hudleston, 1883, from the Permian of Western Australia (*E. dendroidea* Hudleston, 1883, is a species of *Hexagonella*).

The internal structure of the genotype, *E. radiata*, has been described and figured by Ulrich (1884, Pl. 2, figs. 1, 1 *a–c*). Ulrich's figures show the tubular zooecia arising on each side of the mesial lamina, the tubes being slightly indented by the lunaria; there are no hemisepta nor diaphragms; the zooecia are separated by vesicular tissue, replaced by dense tissue as the surface is approached; Ulrich does not mention the presence of maculae in this species, but a portion of a macula is cut on the right hand side of the section figured in his Fig. 1*b*, where a comparatively large area is devoid of zooecia and is occupied by vesicles and dense tissue. In its internal structure, therefore, *E. irregularis* closely approaches the genotype.

Genus Fistulamina, n. gen.*

Fistulamina malmoensis, n. sp. Pl. iii, figs. 1, 2; Text-figs. 12, 15.

Holotype: F.5768E, Univ. Queensland Colln.

Horizon and locality: Riverleigh Limestone, Pors. 21 and 22, Par. Malmoe.

Broad, strap-like Fistulamina; *apertures small, with distinct lunaria, and arranged in 3 to 6 rows on each surface of zoarium; non-poriferous margins of about equal thickness and equally sharp on each side of branch.*

The zoarium is broad and flattened, bifurcating at irregular intervals, typically in the plane of the mesial lamina but occasionally at an angle to this plane; it is from 1·52 to 2·88 mm. in width, and is acutely elliptical in section, its thickness at the centre being from about 0·49 to 1·22 mm.; this thickness is greatest closer to the base of the colony, the branches tapering in thickness near their extremities. The non-poriferous margins of the branches are narrow and are of about equal width on each side; the margin is sharp on each side of the branch, and it is marked by a fine longitudinal ridge, caused by slight projection of the ends of the mesial lamina. The zooecial apertures are arranged rather regularly in longitudinal and in diagonal rows; usually there are four to six, occasionally three, rows on each surface of the zoarium. The apertures are 0·13 to 0·14 × 0·09 to 0·13 mm. in diameter; they are slightly indented by small but distinct lunaria, where about one-third of the circumference is curved to a markedly shorter radius; these lunaria are placed on the side of the aperture closest to an edge of the branch. The apertures are surrounded by slight peristomes, which are

* For generic diagnosis see p. 28.

strongly raised and hood-like on the side on which the lunaria are developed; these hoods are most marked on the lateral rows of zooecia. The centres of successive apertures are spaced 0·51 to 0·71 mm. apart, and there are about 17 apertures in 10 mm. The surface between the apertures is solid and finely granular.

The zooecia lie parallel to the mesial lamina for about 1 mm. and then bend upwards to meet the surface almost perpendicularly. They are not arranged in longitudinal rows between vertical plates, but are separated close to the mesial lamina by a few coarse vesicles and closer to the surface by dense tissue. No diaphragms occur. The internal structure is not well shown in thin section owing to silicification of the zoaria, but both in thin section and on broken edges it is seen to be similar to that shown in *Fistulamina inornata*, n. sp., rather than to the structure shown in species of *Sulcoretepora*, which it resembles externally. It is readily distinguished from *F. inornata* by the differences in their size, in the number of rows of zooecia, and the size of the apertures, and internally by the smaller number of vesicles and by the much larger size of the vesicles developed in this species.

Sub-family Goniocladiinae Waagen and Pichl, 1885.

Goniocladinae* Waagen and Pichl, 1885, 775; = Goniocladiidae Nikiforova, 1938, proposed as a family of the Cryptostomata.

Bifoliate Fistuliporidae; zoaria forming narrow branches, which divide in a plane perpendicular to that of the mesial lamina and may anastomose or form pinnate or irregularly branching zoaria; mesial lamina running from the centre of the obverse to the centre of the reverse surface, and projecting slightly at each end so that both these surfaces are carinate; the carina is typically bordered on both obverse and reverse surfaces by a margin of non-celluliferous tissue, this being much wider on the reverse surface and sometimes almost obsolete on the obverse; zooecial apertures arranged in rows on each side of the carina of the obverse surface; peristomes usually strongly developed, lunaria present or absent; zooecia tubular, without hemisepta, and with diaphragms only very rarely developed; rows of zooecia never separated internally by vertical plates, but they are separated close to the mesial lamina by vesicular tissue, which is replaced by dense tissue as the surface is approached; mesial lamina with fine median tubuli.

Range: Mississippian to Permian.

Waagen and Pichl (1885, 775, 804), who regarded *Goniocladia* and *Ramipora* as members of the Fenestellidae, proposed that these two genera should be separated from the remainder of the family as the sub-family Goniocladinae. Nikiforova (in *Zoological Record*, 1938—the original publication is not available in Australia) has proposed that *Goniocladia, Ramipora, Ramiporalia, Ramiporidra, Ramiporina* and *Volgia* should be grouped together as a separate family of the Cryptostomata, the family Goniocladiidae.

Goniocladia and related genera are closely similar, in internal structure particularly, to *Hexagonella*. Like *Hexagonella*, they differ from *Sulcoretepora*, with which they were for a long time classified, in the shape of their zooecia, in the lack of hemisepta in the zooecia, and in the absence of vertical plates between the rows of zooecia; their internal structure is essentially fistuliporoid. They differ from *Fistulipora* itself in the narrow bifoliate form of their zoaria, in the weak development or absence of lunaria, and in their slightly more geniculate zooecia; like many late Palaeozoic species of *Fistulipora, Hexagonella, Evactinopora*, etc., the vesicular tissue between the zooecia is replaced by dense tissue as the surface is approached, so that the interspaces are solid at the surface. From the Hexagonellinae, these genera differ in the form of their zoaria—in the bifurcation of their branches, typically in a plane at right angles to the mesial lamina instead of in the plane of the mesial lamina, in the orientation of the zooecia towards one surface so that obverse and reverse surfaces may be distinguished, and in their anastomosing, pinnate, or irregularly pinnate, zoaria.

* This spelling is here regarded as a *lapsus calami*, since the sub-family name should have been formed by adding "*inae*", not "*nae*", to the stem of the generic name; it is therefore corrected here to Goniocladiinae.

Like the genera here included in the sub-family Hexagonellinae, *Goniocladia*, *Ramipora*, and the related genera and sub-genera described by Shulga-Nesterenko and Nikiforova from the Russian Carboniferous, appear to form a distinct group of genera, closely related phylogenetically to each other, within the Fistuliporidae, which should therefore be considered as a separate sub-family of the Fistuliporidae, the sub-family Goniocladiinae Waagen and Wentzel. This course is considered preferable to regarding both *Hexagonella* and the genera related to it, and *Goniocladia* and related genera, as belonging to two separate families both separated from the Fistuliporidae, as the characters in which each group differs from typical *Fistulipora* do not appear to be of sufficient importance for the formation of separate families, but to indicate closer phylogenetic relationship of groups of genera within the family.

Genus RAMIPORA Toula, 1875.

Ramipora Toula, 1875, 230; *Ramipora* Toula, Shulga-Nesterenko, 1933, 32, 54; Crockford, 1944, 192.

Sub-genus RAMIPORELLA Shulga-Nesterenko, 1933.

Ramiporella Shulga-Nesterenko, 1933, 39, 56.

Ramipora *with irregularly pinnate zoaria.*

Genotype: *Ramipora* (*Ramiporella*) *asimmetrica* Shulga-Nesterenko, 1933.

Range: Carboniferous.

Shulga-Nesterenko proposed that three sub-genera should be recognized within the genus *Ramipora* for forms which differ from typical *Ramipora* in having either irregularly pinnate or ramose zoaria, or zoaria with limited bifurcation, differing internally in the degree of development of vesicular tissue or in one case in the curvature of the zooecia. *Ramiporella*, the first of these three sub-genera, has a ramose or sub-pinnate zoarium which the species here described from Queensland resembles, and this species is therefore classified in this sub-genus.

RAMIPORA (RAMIPORELLA) FLEXUOSA, n. sp. Pl. iii, figs. 4, 5; Text-fig. 21.

Holotype: F.5768B, Univ. Queensland Colln.

Horizon and locality: Riverleigh Limestone, Pors. 21 and 22, Par. Malmoe.

Fine, irregularly branching Ramipora; *zooecia in two to three rows on each side of the mesial lamina.*

The zoarium arises from a slightly spreading non-celluliferous base, from which two or three thin upright branches arise. The branches are bifoliate, and they typically divide in a plane at right angles to that of the mesial lamina, though one bifurcation in the same plane as the mesial lamina is shown; lateral branches are given off from the main stem at very irregular intervals, and at varying angles. The branches are thin, 0·4 to 0·75 mm. in width perpendicular to the mesial lamina, and about 0·5 to 1 mm. in thickness parallel to it; they are usually very much twisted. They are bifoliate, with the zooecia placed on each side of the mesial lamina, which runs from the centre of the reverse to the centre of the poriferous surface, forming a fine carina along the centre of each surface; the poriferous surface is sharply convex, the reverse rounded. Two to three rows of apertures occur on each side of the carina of the poriferous surface; there are usually three rows along each side of the main branch, but the arrangement of the apertures in these rows is not very regular. The central rows of apertures are not very strongly exserted, but the apertures in the rows closest to the reverse surface are frequently strongly exserted. The apertures are circular, 0·08 mm. in diameter, and no lunaria are shown; they are spaced usually with the centres of successive apertures in the same row from 0·33 to 0·65 mm. apart, and there are about 20 apertures in 10 mm. The surface between the apertures is solid; the reverse surface is finely granular, and is non-poriferous for a width of about 0·36 to 0·55 mm. on each side of its carina.

Owing to the silicification of the specimens, and their brittleness and very small size, it was not possible to prepare slides to show the internal structure; this is shown on broken surfaces of the branches to be very similar to that shown in described species of *Ramipora*: the zooecia are placed back to back along the mesial lamina for a short distance, and then curve outwards rapidly to meet the surface almost at right angles; close to the mesial lamina a few small vesicles are developed between the zooecia, these being gradually replaced by dense tissue as the surface is approached.

From described species of *Ramipora* and of *Ramiporella* this species is distinguished by its extremely fine branches and by the irregular mode of branching of the zoarium.

Order TREPOSTOMATA.

Family BATOSTOMELLIDAE Ulrich.

Genus LEIOCLEMA Ulrich, 1882.

Leioclema Ulrich, 1882, 14; *Leioclema* Ulrich, Ulrich, 1890, 376, 425; Nickles and Bassler (as *Lioclema*), 1900, 33, 302; Moore, 1929, 10; Duncan (as *Lioclema*), 1939, 248.

"*Zoarium ramose, lamellar, sub-globose or incrusting; surface frequently exhibiting distinct monticules or maculae; zooecia with sub-circular or irregularly petaloid apertures, separated by abundant angular mesopores, which in some species are open at the surface, in others closed; diaphragms few in the zooecia, abundant, sometimes crowded, in the mesopores; acanthopores numerous and strong in the typical species, small and inconspicuous in others.*" (Nickles and Bassler, 1900, 33.)

This genus has not previously been recorded from Australia but, as well as the species here described from the Lion Creek Limestone, the genus is known to occur in the Devonian of the Wellington district of New South Wales (specimen 7425, Sydney Univ. Colln.).

LEIOCLEMA POROSA, n. sp. Text-figs. 7, 8.

Holotype: F.6856E, Australian Museum Colln.

Horizon and locality: Lion Creek Oolitic Limestone, Stanwell, near Rockhampton.

Leioclema *with thin laminar zoaria; zooecia almost completely separated by a single row of angular mesopores; acanthopores not numerous.*

The zoarium is a thin laminar expansion, reaching a maximum thickness of some 3 mm. and up to about 2 cm. in diameter. Small monticules in which the zooecial tubes are smaller and the mesopores larger and more numerous occur at distant intervals on the surface of the zoarium.

The zooecial tubes are sub-circular and slightly angular in outline; they are usually between 0·22 and 0·3 mm. in diameter. Small angular mesopores occur abundantly between the zooecia; a single row of these mesopores usually occurs between the zooecia, but occasionally the walls of adjacent zooecia are in contact for a short distance. In 7 sq. mm. there are about 50 zooecial tubes and about four times that number of mesopores. Because of the presence of numerous mesopores the walls of the zooecial tubes are not strongly thickened in the cortical zone. Small acanthopores occur rarely. In longitudinal sections the tubes are thin walled and recumbent for a short distance, about 0·3 mm., at the base of the colony, and then bend upwards to the surface. Thin complete diaphragms are abundant in the zooecial tubes, there being up to 8 in 1 mm. Tabulae are abundant in the mesopores, up to 12 occurring in 1 mm.

There is no described species of *Leioclema* with which this species could be closely compared.

Genus STENODISCUS Crockford, 1945.

Stenodiscus Crockford, 1945, 21.

STENODISCUS STANWELLENSIS, n. sp. Text-figs. 9, 10.

Stenopora leichardtii Nicholson and Etheridge, Etheridge, 1900, 9, Pl. i, figs. 10–12; [non] *Stenopora leichardtii* Nicholson and Etheridge, 1886, 179, Pl. iii, figs. 7–8.

Holotype: F.6857A, Australian Museum Colln.

Horizon and locality: Lion Creek Oolitic Limestone, Stanwell, near Rockhampton.

Small laminar, simulating massive, Stenodiscus; *zooecial tube walls with small, distinct, close spaced monilae; acanthopores of two sizes numerous; thin complete diaphragms occasionally developed, mesopores very rare.*

The zoaria of this species are small laminar colonies, up to about 7 mm. in their maximum height, and expanding over an area more than 20 mm. in diameter; each zoarium is made up of thin laminae 0·5 to 3 mm. in thickness, sometimes discontinuous or partly separated by sediment; the colonies in their thickest part simulate small massive zoaria, and their upper surfaces are irregular, this feature leading Etheridge to describe them as lobate masses. Small indistinct monticules, about 1·5 mm. in diameter and composed of zooecia slightly larger than the average, are developed about 5 to 6 mm. apart on the surface.

The zooecia are tubular; they lie horizontal for about 1 mm. at the base of the colony and also at the base of each lamina, where a fresh layer of zooecia is developed above the thin epitheca occurring at the base of the lamina; above this they bend sharply upwards to meet the surface perpendicularly. Moniliform thickenings appear in the walls of the tubes as soon as they bend upwards; the monilae are small, about 0·12 mm. in length and up to 0·65 mm. in their greatest thickness; about 8 monilae are developed in 1 mm. The zooecial walls between the monilae and in the horizontal part of the zooecial tubes are extremely thin; in tangential section, therefore, the tube walls are either very thin, in which case the tubes themselves appear angular and polygonal, or else thickened, in which case the tubes are rounded, according to whether the section passes through the tube walls between, or at the level of, the monilae. Where the tubes are thick walled, their diameter is usually 0·19 to 0·24 mm., their size being slightly larger, up to 0·27 mm. in diameter, in the monticules. Acanthopores are numerous, and are of two sizes; of these the larger are less abundant, four or five occurring around each zooecial tube, and they are usually developed at an angle of the tube; the smaller acanthopores occur in a single row in the tube walls, and up to about 15 of these surround each tube. Mesopores are of rare occurrence; they are found mainly in the monticules, where three or four occur in the area of each monticule. Thin, complete diaphragms occur very occasionally in a few of the tubes. In an area of 7 sq. mm. there are about 90 to 100 zooecial tubes, with about 4 to 6 mesopores in the same area.

Etheridge (1900) described and figured one of these specimens, which he referred to *Stenopora leichardtii* Nicholson and Etheridge, a species from the Permian of the Bowen River Coalfield in Queensland; these specimens, however, cannot be referred to *S. leichardtii*, from which they clearly differ in the arrangement and development of acanthopores, mesopores, monilae, etc.

This form is of especial interest since, although *Stenopora* is one of the most common and abundant genera in the Permian of Australia, no Carboniferous stenoporids, except this one form recorded by Etheridge, has hitherto been described from here. (De Koninck has made reference to the occurrence of "*Favosites ovata* Lonsdale" in the Lower Burindi Series at Glen William and Burragood in New South Wales; one of his figures (Pl. vii, fig. 5*a*) is probably a stenoporid but the description and figures leave some doubt about this, as Benson (1921, 23) has already discussed, and no other specimens of *Stenopora* are known to have been found in the Lower Carboniferous of New South Wales.)

In one of the thin sections of *Evactinopora irregularis*, however, a ramose batostomellid which appears to be a specimen of *Stenopora* s. str. is sectioned, but the preservation is too poor and the material insufficient for detailed description.

However, stenoporids (i.e., species of *Stenopora, Tabulipora* and *Stenodiscus*) have been described from the Carboniferous of the United States, the British Isles and Russia. This species from the Lion Creek Limestone does not closely resemble in the details of its structure any described form; it can readily be distinguished from any described species of stenoporid from the Permian of eastern Australia by the comparatively tiny size of its zooecial tubes, apart from any other differences.

Order Cryptostomata Vine.

Family Fenestrellinidae Bassler.

Genus Fenestrellina d'Orbigny, 1849.

Fenestrellina d'Orbigny, 1849, 501; *Fenestrellina* d'Orbigny, Bassler, 1935, 111.

Fenestrellina yarrolensis, n. sp. Pl. i, fig. 1; Text-fig. 16.

Holotype: F.5769C, Univ. Queensland Colln.

Horizon and locality: Oolitic Limestone, Por. 193, Par. Mundowran.

Very fine Fenestrellina; *fenestrules rectangular, one to two zooecia to a fenestrule; nodes high, sharp, closely and evenly spaced.*

The zoarium is very fine meshed, there being about 25 fenestrules and 30 branches in 10 mm. The branches are straight, 0·24 to 0·31 mm. wide, and bear two rows of zooecial apertures separated by a slight carina, on which there is a single row of high, spine-like nodes, placed 0·24 mm. apart; 42 of these nodes occur in 10 mm. Most of the zooecial apertures have been considerably enlarged by weathering, but where they are best preserved they are small and circular, 0·12 mm. in diameter, and are surrounded by slight peristomes. There are either one or two apertures to a fenestrule, and about 45 in 10 mm., the distance between the centres of successive apertures being 0·2 to 0·27 mm., but usually about 0·22 mm. The fenestrules are rectangular, 0·22 to 0·3 mm. long and 0·09 to 0·13 mm. wide; the width of the dissepiments is 0·06 to 0·13 mm., and the length of one fenestrule and one dissepiment from 0·35 to 0·4 mm. On the reverse surface both branches and dissepiments are evenly rounded, and they are of about the same thickness. Silicified fibrous tissue forms an overgrowth over part of the reverse surface.

A number of species similar in size to this form have been described from the Carboniferous of North America and Russia, but the spacing of the zooecia and of the nodes of this form is more distant compared with the size of the fenestrules than in any described species. *Fenestrellina pectinis* (Moore), 1929, from Pennsylvanian of Texas, is of similar size, but there are fewer fenestrules in 10 mm., and these are hour-glass shaped owing to the very regular arrangement of the apertures, two to a fenestrule; *F. limbata* (Foerste), 1887, is also similar in size, but has pyriform apertures, of which there are two to three to a fenestrule.

Fenestrellina, sp. indet. Text-figs. 17, 18.

Specimen: F.5768G, Univ. Queensland Colln.

Horizon and locality: Riverleigh Limestone, Pors. 21 and 22, Par. Malmoe.

Fenestrellina *with long, rectangular fenestrules and very thin branches and dissepiments; four to seven apertures to a fenestrule; carina absent.*

There are about 4 fenestrules and 10 branches in 10 mm. The branches are straight, 0·22 to 0·35 mm. wide, and bifurcate frequently. They are rounded on the obverse surface, and there are two rows of zooecial apertures, placed on the sides of the branches; no carina is developed, the surface between the apertures being ornamented only by swirling ridges and grooves; nodes are not well shown but appear to have been occasionally developed. The apertures are circular, 0·11 mm. in diameter, and they are surrounded by slight peristomes; there are usually four to seven, most often five to six, apertures to a fenestrule, the distance between the centres of successive apertures being 0·38 to 0·46 mm., and there are about 24 in 10 mm. The fenestrules are rectangular, about 1·3 to 2·0 mm. long and 0·5 to 0·75 mm. wide; the width of the dissepiments is 0·11 to 0·17 mm. On the reverse surface both branches and dissepiments are rounded and finely granular, the dissepiments being much thinner than the branches.

This very coarse *Fenestrellina*, with its distinctive slender branches without carinae, occurs associated with *Archimedes regina*, n. sp.

Genus Polypora M'Coy, 1845.

Polypora M'Coy, 1845, 207.

Polypora sulcifera, n. sp. Pl. i, fig. 2; Text-fig. 13.

Holotype: F.5768C, Univ. Queensland Colln.

Horizon and locality: Riverleigh Limestone, Pors. 21 and 22, Par. Malmoe.

Fine Polypora, *zooecia usually in 3 rows, 3 to 6 to a fenestrule; apertures strongly exserted, surface of branches deeply sulcate.*

The zoarium is fenestrate, with about 6 fenestrules and 11 branches in 10 mm. The branches are narrow and flattened, 0·35 to 0·4 mm. wide; usually there are 3 rows of zooecial apertures, with 3 to 5 before, and 2 to 3 after, bifurcation. The apertures are circular and are very small, 0·08 mm. in diameter; when perfectly preserved they are very much exserted and almost stalked. There are three to six zooecia to a fenestrule; over most of the colony there were probably five to six, as it is only where the branches were rapidly bifurcating and the fenestrules shortened, apparently close to the base of the colony, that there is a smaller number; the distance between the centres of successive apertures is 0·3 to 0·44 mm., and there are 29 apertures in 10 mm. The fenestrules are oval, from 0·86 to 1·96 mm. long and 0·2 to 0·27 mm. wide; the width of the dissepiments is 0·16 to 0·27 mm., and the length of one fenestrule and one dissepiment 1·1 to 2·2 mm. On the reverse surface both branches and dissepiments are granular; the dissepiments are usually about the same thickness as the branches, but are sometimes very much thinner.

The small dimensions of the zoarium, together with the strongly exserted apertures and deeply furrowed surface of the branches, distinguish this species from described species of *Polypora*. The occurrence of this species of *Polypora* in the Riverleigh Limestone is of interest because, amongst the comparatively large collections examined from the Burindi and Lower Kuttung Series in New South Wales, in which *Fenestrellina* and *Hemitrypa* are very abundant, there was not a single specimen of *Polypora*, and no specimens of this genus were observed in any of the other smaller collections from the Lower Carboniferous of Queensland.

Genus Archimedes Owen, 1842.

Archimedes Owen, 1842, 19; *Archimedes* Hall, 1857, 176; *Archimedes* Hall, Condra and Elias, 1944, 1; synonym: *Archimedipora* d'Orbigny, 1850, 502; *Archimedipora* d'Orbigny, Easton, 1943, 142, and 1944, 406.

Growth-form consists of zoarial meshwork as in Fenestrellina, *with branches bearing two rows of zooecial apertures on one side and connected by more or less regularly spaced cell-less dissepiments; coiled in a more or less regular helicoid, encrusted differentially by fibrous tissue; screw coiling sinuous or straight, slightly to heavily encrusted.* (Adapted from Condra and Elias, 1944, 64.)

Genotype: *Retepora archimedes* Owen, 1842.

Range: Upper Silurian (?) to Permian.

The validity of this generic name has been the subject of lengthy discussion by Condra and Elias (1944) and by Easton (1943, 1944), and these writers have already discussed the history of the use of the names *Archimedes* and *Archimedipora* at some length. The present position with regard to these names is that Condra and Elias consider that *Archimedes* is the valid name for this group of fossils, and they regard Hall (1857) as its author, since they hold the view that Owen in 1842 designated the species "*Retepora Archimedes*" and not the genus *Archimedes*; they consider the genotype of *Archimedes* to be *Archimedes wortheni* Hall, 1857. Easton, on the other hand, holds that *Archimedipora* d'Orbigny, 1850, is the valid name for this genus of bryozoans, since d'Orbigny's publication antedates that of Hall, and there can be no possible doubt as to the identity of the genus to which the two names have been applied; d'Orbigny designated the species figured by Owen as "*Retepora Archimedes*" as genotype; as neotype of this species, Easton has selected the holotype of *Archimedes wortheni* Hall, 1857. Controversy has arisen as to the validity of this selection of a neotype, and it appears to me that, despite Easton's arguments to the contrary, Condra and Elias are correct in regarding this selection invalid because the holotype of *Archimedes wortheni* is not a topotype of Owen's species.

Even so, if Condra and Elias be correct in stating that Hall is the author of the name *Archimedes*, the fact still remains that *Archimedipora* was proposed for the same genus prior to Hall's publication in 1857.

Owen's original usage of the name *Archimedes* is incidental to a discussion of the age of the limestone in which it occurs, and his description of the specimen he figured is ambiguous on the question of whether he intended to propose a new genus or a new species; it appears to me that it is quite open to either interpretation, as Owen quite clearly refers to both possibilities and refers to the form he figured as *Archimedes* in the text and as *Retepora archimedes* in a foot-note. It therefore appears to me that Owen (1842) can be considered the author of the generic name *Archimedes*, and therefore that *Archimedipora* d'Orbigny is a synonym; this course appears quite reasonable from Owen's original discussion, and such an interpretation seems desirable in that it avoids rejection of the long-used and well-known name *Archimedes* in favour of *Archimedipora*; in this paper, therefore, *Archimedes* is used as the valid name for this group of fossils. At the same time it is considered that, since so much controversy has arisen about this name, and since the question of its validity is very involved and ambiguous, and is undoubtedly open to varying interpretation by different authors, application for a definite ruling upon this question should be made to the International Commission on Zoological Nomenclature, when this Commission again commences to function, in order to obtain stability in the naming of this genus.

Condra and Elias, in their monograph on this genus, have succeeded in the enormous task of carefully and precisely revising and figuring almost all the described species of the genus, and they have discussed every record of its occurrence. Apart from one species, described from Spitzbergen by Toula in 1885, all of the described species are from the United States and Russia, although single records of the occurrence of the genus in Africa and in England, as well as Whitehouse's record of *Archimedes* from Queensland, have been made.

Archimedes is extremely rare in the Silurian and Devonian, one species having been described from each of these periods; it reaches its maximum abundance in the Mississippian of the United States, 30 or more species being known from rocks of this age; the majority of these species occurs in the Chester Series of Illinois. A smaller number of species occurs in the Lower Pennsylvanian of Utah, but they are not known in rocks of this age from any other part of the United States. In Russia, *Archimedes* first appears in the Upper Carboniferous (doubtfully in the Middle Carboniferous) and extends into the Lower Permian. It is therefore interesting that these two species from Queensland have been found in rocks of Lower Carboniferous age; they are from the Upper Viséan, and therefore from strata approximately equivalent in age to the Chester Series in which the genus is so abundant in America. Condra and Elias (1944, 184) state that:

"The Lower Pennsylvanian of Utah is the highest horizon in which *Archimedes* is known in the United States. Since, in Northern Russia, the genus is only found in the Middle Carboniferous and up, it is significant that with the advance of time the *Archimedes* appears in stratigraphically higher rocks of the western than of the eastern part of North America. Many other marine invertebrates, particularly brachiopods of Pennsylvanian and Permian rocks of the western States, show marked affinities with contemporaneous Himalayan and Uralian forms, which suggest the route of migration between North America and Asia at the present time."

The early appearance of the genus in Australia, however, does not lend any support to this theory, though it does not of necessity contradict it.

Condra and Elias have formulated the interesting hypothesis that *Archimedes* is a symbiotic growth of a bryozoan and an alga. While the idea that the thick tissue of the screw and flange may have been deposited by an alga as the meshwork was built up by a species of *Fenestrellina* is extremely interesting, it is open to criticism on many points, as Easton has indicated; many of the features which are explained by this hypothesis can be equally well explained by comparison with the base of a normal fenestellid colony, where excessive calcium carbonate is deposited to form a stronger base, and rootlets, identical with those elaborately accounted for in this theory as algal fibres, are very commonly developed as supports from the lower surface of a fenestellid colony; examination of these deposits, the bryozoan origin of which is beyond doubt, does not suggest that their origin could be different from the origin of the axial support of *Archimedes* or the lateral supports developed in *Lyropora*. One of the greatest weaknesses of Condra and Elias's presentation of this theory is that they have not attempted to compare in adequate detail the axial deposits of *Archimedes* with the deposits found strengthening the base of most large and old fenestellid colonies. Condra and Elias's explanation is so elaborately presented and has been based on such a vast amount of carefully prepared material that detailed criticism of it based on the silicified specimens from Queensland described in this paper would be inadequate, but further proof of their theory seems very necessary before it can be accepted.

ARCHIMEDES REGINA, n. sp. Pl. ii, figs. 1, 2; Text-figs. 11, 20.

Archimedes (pars), Whitehouse, 1929, xii; Hill, 1934, 105.

Holotype: F.5768A = F.5608, Univ. Queensland Colln.

Horizon and locality: Riverleigh Limestone, Pors. 21 and 22, Par. Malmoe.

Archimedes *with a loosely-coiled cork-screw axis, with 1·5 volutions in 2 cm.; flange flaring; frond funnel-shaped, angle of divergence 60° to 70°, coarse meshed, with 10 branches and 6 to 7 fenestrules in 10 mm., 4 to 6 apertures to a fenestrule, carina with small, distant nodes.*

The holotype is portion of a screw, 3·5 cm. long, and comprising parts of four volutions, each with a considerable amount of the frond still attached. The rather thick shaft is cork-screw type; it is 4 mm. in diameter at this part of the zoarium, and it grades gradually into a flaring flange, about 13 to 16 mm. in diameter. On the expanse at the second volution preserved, the thickening of the flange is produced outwards along three or four branches and there is then a short gap in the expanse near the flange, as if part of the meshwork near the axis had been broken away during growth and the edges of the gap so formed had then been thickened. The volution height is about 1·3 cm., so that there are 1·5 volutions in 2 cm.

At the widest part preserved, the frond extends outwards for 3 cm. from the edge of the flange; it forms a funnel-shaped coil around the axis, from which it diverges at an angle of 60° to 70°. The frond is coarse meshed, there being 10 branches and 6 to 7 fenestrules in 10 mm. The branches are straight, about 0·5 mm. wide, and bear two rows of apertures; the carina is broad and indistinct, and there is a single row of small, rounded nodes, spaced 0·59 to 0·67 mm. apart. The apertures are small, circular (about 0·08 mm. in diameter), and are exserted; the distance between the centres of successive apertures is 0·28 to 0·36 mm., and there are about 31 apertures in 10 mm.; there are four to six apertures to a fenestrule. The fenestrules are oval, 0·95 to 1·68 mm. long and about 0·4 to 0·6 mm. wide; the dissepiments are without tubercles and are from 0·4 to 0·6 mm. wide. On the reverse surface both branches and dissepiments are evenly rounded, and they are of about the same thickness; the branches are ornamented on this surface by fine longitudinal striae. In addition, several pillars arise from the reverse surface and pass backwards perpendicularly to the surface of the frond beneath; these pillars range from about 0·75 to 2 mm. in diameter; rather numerous blunt nodules on the reverse surface of some parts of the frond represent the broken ends of additional pillars. The zooecia themselves are triangular in outline on the basal plate.

The upper end of the shaft appears to have been damaged during growth, and from the expanse on the left-hand side of the end (Pl. ii, fig. 1) and about 11 mm. from the axis a small adventitious shaft, of which only about 4 mm. near the base now remains, had commenced to grow.

This species occurs in the Riverleigh Limestone, which contains a *Lithostrotion–Amygdallophyllum* fauna, and is of Upper Viséan age, or possibly very slightly younger; the coral fauna has been described in detail and the age of the fauna fully discussed by Hill (1934; 1943, 62).

A. regina is remarkable amongst described species of *Archimedes* for the coarseness of the meshes of the frond, the largest known number of zooecia to a fenestrule in other species being from three to four. The most similar described species is *A. girtyi* (Condra and Elias), 1944, from the Pennnsylvanian of Utah, but this form, although it has a similar type of screw, has a very much finer mesh in the frond.

ARCHIMEDES SPIRALIS, n. sp. Pl. ii, figs. 3–6; Text-fig. 14.

Archimedes (pars), Whitehouse, 1929, xii; Hill, 1934, 105.

Holotype: F.5609, Univ. Queensland Colln.

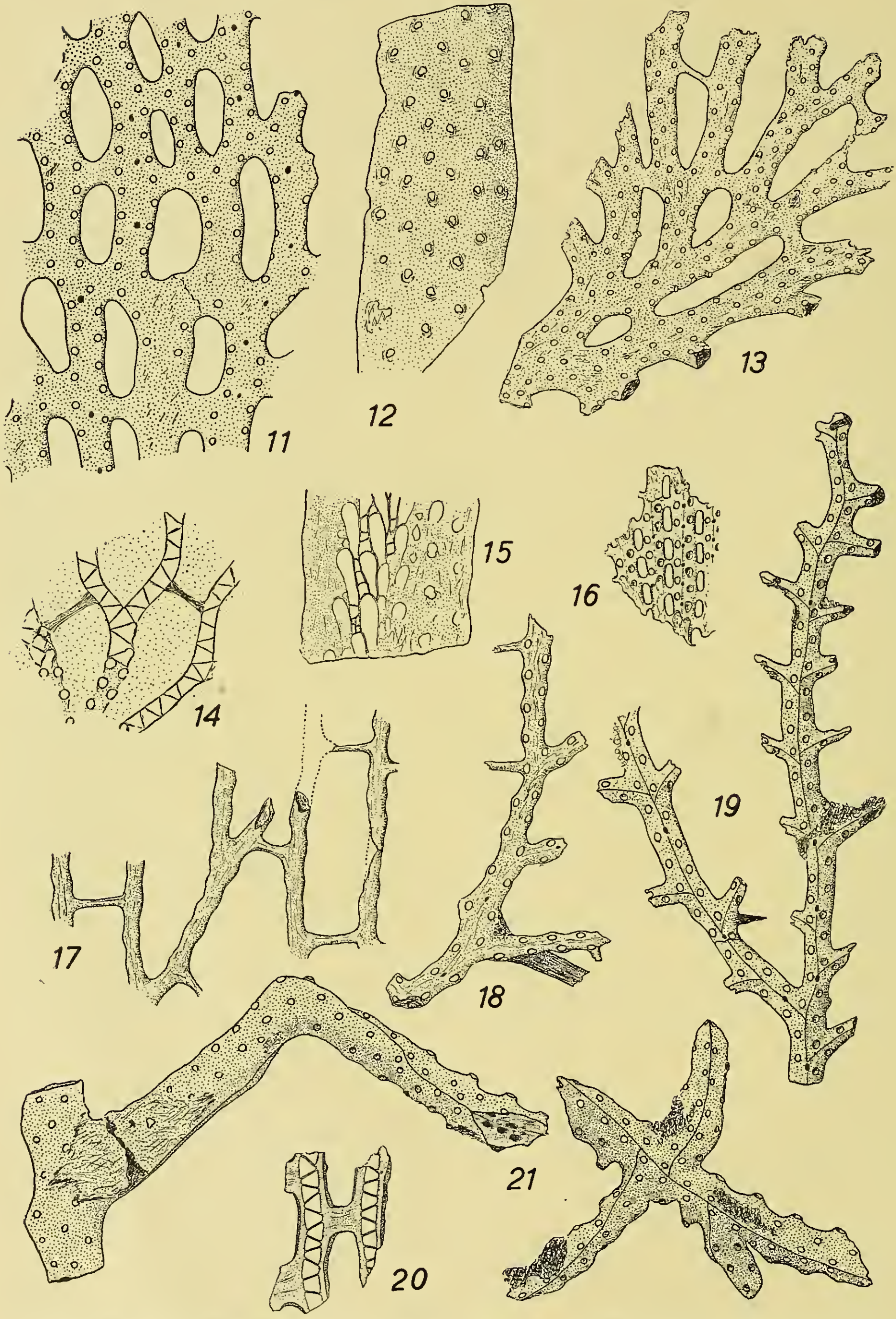
Horizon and locality: Riverleigh Limestone, Pors. 21 and 22, Par. Malmoe.

Archimedes *with an exposed cylindrical screw and narrow, slightly flaring flange; 2·5 volutions to 2 cm.; angle of divergence of frond about 65° to 70°, frond coarse meshed.*

The holotype is portion of a long, curved screw, 10·3 cm. in its total length, and comprising about 13 volutions; the frond has been broken off along its line of junction with the axis. The screw was originally more or less fusiform, but was considerably deformed during the growth of the zoarium. Between the sixth and seventh volutions the shaft was fractured obliquely, and later more or less completely cemented together at this point; after fracture the lower part of the screw must have been more or less recumbent, and the upper part curved sharply upwards away from the original direction of growth; at the time the shaft was fractured the frond was broken away from the axis almost completely from the third to seventh volutions and partly from the eighth and ninth, and the tissue of the shaft and flange has almost completely grown over and covered the broken edges of the frond in this part of the zoarium; in addition, there was a profuse growth of rootlets, some of them very long, thick, and forked, from the lower side of the zoarium beneath and just above the fracture. Unfortunately the limestone in which this silicified specimen was preserved contains numerous tiny cross fractures, and these, crossing the fragile rootlets, caused them to break up into short segments as the specimen was gradually etched from its matrix; the broken bases of these rootlets remain on the shaft; one of the broken rootlets is shown in Pl. ii, fig. 3.

The shaft is cylindrical, being a "straight" mechanical screw, and is exposed and slightly fusiform; in the lowest two volutions preserved, the shaft is very thin and almost cork-screw in character; above this a ring of rootlets joins the shaft; these are up to 1·5 mm. thick where they join the shaft, and as they occur all around the shaft and not only on the lower side, supported the zoarium before it was fractured; the shaft then thickens abruptly and from this point on is cylindrical. The flange is narrow and slightly flaring, and leaves the shaft well exposed. The diameter of the shaft for the first two volutions was only about 1·7 mm.; above this the diameter of the shaft varies from 4·8 mm. at the base to 6·3 mm. at its thickest part and 4·3 mm. at the highest volution preserved; the maximum diameter of the flange is up to 9·0 mm. The volution height is 7·5 to 9·2 mm., so that there are almost 2·5 volutions in 2 cm.; the shaft is exposed for about 4 to 5 mm. between successive volutions, and the frond was given off at an angle of about 65° to 70°. The surface of the tissue of the shaft shows faint striae, which are straight on the exposed surface of the shaft and then flare outwards over the base and inwards over the upper surface of the flange.

Unfortunately the specimen fractured into small pieces so rapidly and the silicified tissue of the shaft and flange adhered so firmly to the surface of the branches of the fenestrate part of the zoarium, except where it had been naturally weathered along their contact, that it was impossible to expose the fenestrate part of the zoarium satisfactorily; the flange and part of the shaft at one volution were chipped off and the surface polished until the level of the meshwork was reached (Text-fig. 14). This shows that the fenestrules are very long, from at least more than 1·35 mm. to more than 1·6 mm. in length; from the broken edges of the frond also it is clear that the fenestrules must have been very long, as, although when the branches and dissepiments are weathered out from the shaft tissue they stand out very clearly and distinctly from the tissue of the flange, quite long distances of a branch are often shown clearly without any sign of a dissepiment being present or of its having been broken off. The width of the fenestrules is about 0·5 to 0·95 mm., and the width of the dissepiments 0·16 to 0·24 mm. The branches are about 0·21 mm. wide immediately after bifurcation, their width increasing to up to 0·4 mm.; there are two rows of



Text-figs. 11, 20.—*Archimedes regina*, n. sp., × 10. 11. Obverse surface of the frond of the holotype. 20. Fragment of the frond of the holotype ground down from the reverse surface to show the shape of the cells close to the basal plate.

Text-figs. 12, 15.—*Fistulamina malmoensis*, n. sp., × 10. 12. Surface of the holotype. 15. Oblique tangential section of a second specimen etched from the same piece of limestone.

Text-fig. 13.—*Polypora sulcifera*, n. sp. × 10. Obverse surface of the holotype.

Text-fig. 14.—*Archimedes spiralis*, n. sp., × 10. Fragment of the flange of the holotype ground down to the level of the meshwork.

zooecia, increasing to three only immediately before a branch bifurcates; the zooecia are triangular in outline, and just after bifurcation they form an only slightly staggered row. There were evidently about six to seven zooecia to a fenestrule, and about 30 in 10 mm., the distance between the centres of successive apertures being 0·29 to 0·36 mm. The zooecial apertures are rounded, 0·11 mm. in diameter; no sign of a carina or of nodes could be seen. The dissepiments are depressed below the level of the branches on both obverse and reverse surfaces.

This species is differentiated from *A. regina*, n. sp., by its different type of screw and shorter volution height; the fenestrate part of the zoarium also appears to have had thinner branches, longer fenestrules, and finer branches than *A. regina*; these two species both occur in rocks of Upper Viséan age, associated with an *Amygdallophyllum-Lithostrotion* coral fauna. The coarseness of the fenestrate part of the zoarium separates this species from any other described species of *Archimedes*.

Family ACANTHOCLADIIDAE Zittel.

Genus PENNIRETEPORA d'Orbigny, 1849.

Penniretepora d'Orbigny, 1849, 501; *Penniretepora* d'Orbigny, Bassler, 1935, 165.

PENNIRETEPORA FRAGILIS, n. sp. Pl. iii, fig. 3; Text-fig. 19.

Holotype: F.5768D, Univ. Queensland Colln.

Horizon and locality: Riverleigh Limestone, Pors. 21 and 22, Par. Malmoe.

Fine Penniretepora; *three, rarely two to five, zooecia between the origins of successive branches; slight carina, with small, distant nodes.*

The zoarium is pinnate; the midrib is very thin, 0·5 mm. wide at its lower end, tapering gradually to 0·28 mm. at the top. The lateral branches, which are usually placed almost level with each other on opposite sides of the midrib, are given off at an angle of from 45° to 75°; they are from 0·25 to 0·4 mm. wide, and the carinae of successive branches are spaced 0·71 to 1·68 mm., but usually between 1·0 and 1·24 mm., apart; there are about 8·5 lateral branches in 10 mm. One of the lateral branches is itself pinnate, the first branch arising from it 1·03 mm. from the midrib; the spacing of the laterals on this branch is the same as their spacing on the midrib. The zooecial apertures are small and rounded, about 0·1 mm. in diameter, and they are in two rows, separated by a slight carina; small nodes were developed at distant intervals (about 0·9–1·2 mm.) on the carina. On the midrib there are usually three apertures between the points of origin of successive branches, but this number varies from two to five. There are 28 apertures in 10 mm. on the midrib, the distance between the centres of successive apertures being 0·31 to 0·44 mm.; the spacing is similar on the lateral branches. The surface between the apertures is ornamented by tiny granules, as is also the reverse surface.

Family RHABDOMESONTIDAE Vine.

Genus RHABDOMESON Young and Young, 1874.

Rhabdomeson Young and Young, 1874, 337; *Rhabdomeson* Young and Young, Moore, 1929, 141; Crockford, 1944, 166.

RHABDOMESON, sp. indet. Text-fig. 22.

Specimen: F.5769B, Univ. Queensland Colln.

Horizon and locality: Oolitic Limestone, Por. 193, Par. Mundowran.

The zoarium is ramose, the specimen being a hollow, cylindrical branch; the section is 2·16 mm. long, and passes through the centre of the zoarium; the zoarium is 1·19 mm. in width at the widest point cut in the section. The axial canal reaches a diameter of

Text-fig. 16.—*Fenestrellina yarrolensis*, n. sp., × 10. Obverse surface of the holotype.

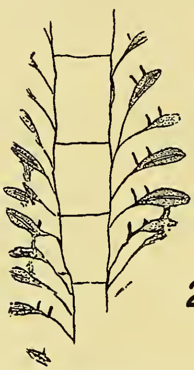
Text-figs. 17-18.—*Fenestrellina*, sp. indet., × 10. Reverse and obverse surfaces of specimen F.5608, Queensland Univ. Colln.

Text-fig. 19.—*Penniretepora fragilis*, n. sp., × 10. Obverse surface of the holotype.

Text-fig. 21.—*Ramipora* (*Ramiporella*) *flexuosa*, n. sp., × 10. Two adjoining fragments of the holotype, which fractured along the broken surface shown.

0·36 mm., and appears to have been divided up by thin, straight diaphragms, spaced about 0·46 mm. apart. The zooecia are short, and they diverge from the outer margin of the axial canal at an angle of from about 30° to 45°, and on the lower right-hand side of the section, the only part in which the surface has not been worn away, they curve outwards at the base of the cortical zone to meet the surface at right angles. The zooecia are thin walled close to the axial tube, but the walls are about 0·08 mm. thick in the cortical zone, which is 0·28 to 0·32 mm. in radius. The apertures were about 0·16 mm. long and there were about 4 apertures in 1 mm. longitudinally. There are no diaphragms, but one or two very prominent superior hemisepta are developed in each zooecium at the base of the vestibule. A few comparatively large acanthopores are shown in section.

This single tiny specimen of *Rhabdomeson* was cut in one of the thin sections of the oolitic limestone containing *Evactinopora irregularis*, n. sp.; it is here figured and described as a record of the occurrence of this interesting genus in the Carboniferous of Queensland.



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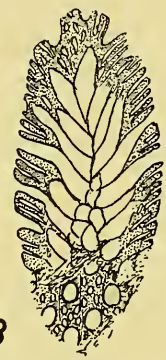

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Text-fig. 22.—*Rhabdomeson*, sp. indet., × 20. Thin section through a zoarium cut in one of the slides of *Evactinopora irregularis* (specimen F.5769, Univ. Queensland Colln.).

Text-fig. 23.—*Streblotrypa*, sp. indet., × 20. Thin section through a zoarium cut in one of the slides of *Dybowskiella crescentica* (specimen 6448, Sydney Univ. Colln.).

Genus Streblotrypa Ulrich, 1890.

Streblotrypa Ulrich, 1890, 403, 665; *Streblotrypa* Ulrich, Bassler, 1929, 66; Crockford, 1944, 168.

Streblotrypa, sp. indet. Text-fig. 23.

Specimen: 6448B, Sydney Univ. Colln.

Horizon and locality: Crinoidal Limestone, Old Cannindah Homestead, near Monto, Queensland.

Two small fragments of a new species of *Streblotrypa* are shown in a section made from the crinoidal limestone at Cannindah, and they are described here for the purpose of recording the occurrence of this genus in the Lower Carboniferous of Queensland.

The zoarium is ramose, the branches being from 0·8 to 1 mm. in diameter; there appear to have been about 10 longitudinal rows of zooecial apertures. The apertures are oval, 0·13 × 0·16 mm. in diameter, and were arranged in regular longitudinal and apparently also in diagonal rows. The distance between the centres of successive apertures was about 0·31 mm. The area behind each aperture contains about five mesopore pits, and where they are most clearly shown these are arranged in quincunx. No acanthopores occur. The zooecial tubes are relatively rather long, being about 0·65 mm. in length. They diverge from an imaginary axis running through the centre of the branch and curve upwards for some distance, then bend outwards more sharply to the surface. Neither hemisepta nor diaphragms were observed in these sections. The mature zone is from about 0·16 to 0·22 mm. in width.

Like *Streblotrypa parallela*, n. sp., from the Lower Burindi Series of New South Wales, this species, with its zooecia diverging from the centre of the zoarium without the occurrence of a central bundle of small tubes, appears to be a typical Lower Carboniferous representative of this genus.

Part II. Lower Carboniferous Bryozoa from New South Wales.

Although Bryozoa are abundant in the lower Carboniferous rocks of New South Wales and were first recorded from them as long ago as 1847, when M'Coy (1847, 226) briefly recorded "*Fenestella undulata* Phil." and "*Glauconome* . . . allied to the *G. pluma* (Phil.)" from Dunvegan on the Paterson River, very little research has since been done on this group from the Carboniferous here. Benson (1921) has listed forms described or recorded from the Burindi Series of New South Wales prior to that date; the Bryozoa listed in his Index amount to a total of twenty-seven forms, referred at that time to fifteen genera. This list is deceptively long; it includes many records which, while they serve to indicate the localities at which Bryozoa principally occur, refer only to manuscript names, or to records, unaccompanied by a description or by figures, of the occurrence of either a species or a genus: and upon such records, which usually refer to one of the species described by Lonsdale from the Permian of Tasmania or to a European Carboniferous species, no reliance at all can be placed. Excluding these brief records, there were ten species occurring in the Burindi of New South Wales of which descriptions accompanied by figures had been given prior to the publication of Benson's Index. Of these ten species, three were species described as new by Chapman in 1920 (366–7), and the remainder, four European species and three new species, were described and figured by de Koninck in 1877 (128–140). Since 1921 no species occurring in the Lower Carboniferous of New South Wales has been described or figured, although the lists of fossils in several papers dealing with Carboniferous stratigraphy mention the occurrence of different genera and species of Bryozoa.

Fistulipora microscopica Chapman, *Cycloidotrypa australis* Chapman, and *Hallopora fruticosa* Chapman were described from material collected from the Burindi Series in the Parish of Moorowarra, near Somerton, *Cycloidotrypa* being described as a new genus. Unfortunately it is impossible to recognize these species from the descriptions or illustrations, and the type specimens (in the collections of the Mining Museum, Sydney, G. S. Reg. 4405, according to Benson) appear to be lost.

The specimens which de Koninck described were amongst the collections made in Australia by Rev. W. B. Clarke, and sent by him to Europe for description; when they were returned to Australia these specimens were placed in the Exhibition held in the Garden Palace in Sydney; this building was burnt in 1882 and the specimens therefore lost. The difficulty of identifying some of de Koninck's species is increased by the fact that several of the locality names which he used cannot now be traced and it is not therefore possible to collect topotype material.

The three new species which were described by de Koninck from Burindi localities are *Dendricopora hardyi*, *Fenestella propinqua*, and *Retepora* ? *laxa*, the first of these being the type of a new genus.

Dendricopora hardyi de Koninck (de Koninck attributes the specific name to Clarke, who had suggested it in manuscript) is a *Ptilopora*-like form; Bassler (1935, 90) has listed *Dendricopora* as a synonym of *Ptilopora* M'Coy, but according to de Koninck's description, *Dendricopora* possesses three instead of two rows of cells on both midrib and branches, and if this statement be correct, *Dendricopora* is a distinct genus. There were unfortunately no specimens in the collections used for this paper which could be identified with either de Koninck's figures or his description of this form; *Ptilopora konincki*, n. sp., has a similar growth form to *D. hardyi*, but has only two rows of zooecia, and is furthermore too small a species to be identified with de Koninck's description.

The other two new species described by de Koninck are revised in this paper as *Fenestrellina propinqua* (de Koninck) (pp. 35–36) and *Goniocladia laxa* (de Koninck) (pp. 29–31).

Four European species of Bryozoa were also described and figured by de Koninck from Burindi localities. These were recorded as *Penniretepora grandis*, *Fenestella plebeia*, *Fenestella multiporata* and *Polypora papillata*, all species originally described by M'Coy from the Carboniferous limestone of Ireland in 1845. The figures and descriptions of these four species given by de Koninck do not correspond sufficiently closely with those given by M'Coy to suggest that the Australian specimens were identical specifically with those described by M'Coy. *Fenestella fossula* Lonsdale, 1844, was considered by de Koninck to be a synonym of *Fenestella plebeia* M'Coy; Etheridge (1892) has already shown that de Koninck's description of specimens from the Burindi differs widely from Lonsdale's description of *F. fossula* from the Permian of Tasmania, and this record of the occurrence of *F. fossula* in the Burindi Series is therefore incorrect.

No species of bryozoan occurring in this material from the Burindi Series, or in material from marine intercalations in the Lower Kuttung Series in New South Wales, could be identified or even closely compared with any species known to occur in the Permian here. Indeed, the whole aspect of the two faunas is different; as has been pointed out in the introduction to this paper, the Carboniferous contains a fauna of a much more varied type than the Permian.

Amongst the fenestellids, the species occurring in the Burindi and Kuttung are of quite a different type to the Permian forms—in the Burindi and Lower Kuttung, fenestellids with small triangular or ovoid zooecia and fragile branches and dissepiments predominate, whilst the Permian forms are more robust, and almost without exception have larger, rhomboid zooecia. Benson (1921, 6) pointed out that of a total of some three hundred species known to occur in the Burindi, only thirteen species were at that time considered to extend into the Permian in New South Wales; of the thirteen species he so listed, five are Bryozoa, all of them fenestellids, and it is improbable that any of the species so listed do occur in both the Lower Carboniferous and Permian.

The full localities from which the specimens described from New South Wales were collected are as follows:

Glen William: Lower Burindi Series, Glen William, where the thin horizon in which Bryozoa occur abundantly forms a ridge west of the Glen William–Clarencetown Rd. in Pors. 201 and 204, west part of 22 and east part of 21, Par. Wallarobba, Co. Durham; this horizon lies about 200′ below the base of the Lower Kuttung Series in this area, and is believed to be the locality referred to as Glen William by de Koninck.

Hilldale: Lower Burindi Series, near Hilldale Railway Station, in Pors. 100 and 102, Par. Barford, Co. Durham; the horizon rich in Bryozoa lies about 400′ to 500′ below the base of the Lower Kuttung Series, and is probably to be correlated with the bryozoan horizon at Glen William.

Barrington: Outcrop of fossiliferous mudstones on the bank of the Williams R., about 100 yds. from Barrington House, Barrington Tops; this horizon probably lies within the Lower Burindi Series, but it cannot at present be closely correlated with horizons in other areas.

Rouchel Brook: Marine intercalation in the freshwater Lower Kuttung Series, banks of Rouchel Brook, just upstream from the Cameron Bridge, in Pors. 1 and 34, Par. Rouchel, Co. Durham; this horizon is a thin fossiliferous marine tuffaceous mudstone horizon intercalated in the Lower Kuttung Series about 800′ to 1,000′ above its base (a large part of the Lower Kuttung Series below this horizon consists of lava flows and coarse conglomerates). The facies and fauna of this horizon are distinct from those of the Upper Burindi limestone facies intercalated on higher horizons in the lower Kuttung Series.

Back Creek: Marine intercalation in the freshwater Lower Kuttung Series, in Back Creek at its junction with Woolooma Gully, in Por. 34, Par. Doon, Co. Durham.

This locality is close to Rouchel Brook (of which Back Creek is a tributary) and is believed to represent the same horizon.

Taree: Upper Burindi Series, in Taree Quarry, Por. 18, Par. Taree, Co. Macquarie; this area has been mapped and the fauna of this horizon has been discussed by Voisey (1938).

Description of Species.

Order Cyclostomata Busk.

Family Fistuliporidae Ulrich.

Sub-family Fistuliporinae, n. sub-fam.

Genus Fistulipora M'Coy, 1850.

Fistulipora M'Coy, 1850, 131; *Fistulipora* M'Coy, Ulrich, 1890, 382, 474; Bassler, 1929, 41.

Fistulipora mirari, n. sp. Pl. iv, fig. 4; Text-fig. 26.

Holotype: 6432, Sydney Univ. Colln.

Horizon and locality: Lower Burindi Series, Glen William (holotype); Lower Burindi Series, Hilldale (7404, Sydney Univ. Colln.).

Fistulipora *with a very thin, spreading unilaminate zoarium; zooecial tubes short, indented by slight lunaria, and separated by coarse vesicular tissue.*

The zoarium is an extremely thin spreading expansion, 0·5 to 1 mm. in its total thickness, and may be either flat or rather buckled; none of the specimens observed were attached at the lower surface; the zoaria are unilaminate, the tubes arising from a very thin basal lamina and curving to meet the surface obliquely; the length of individual tubes is usually 0·8 to 1·1 mm. The zooecial apertures are 0·28 to 0·36 mm. in diameter, and they are indented by the development of a thin lunarium at the proximal side of each tube, the tube wall being curved to a slightly shorter radius around about one-third of its circumference (Text-fig. 26). In 7 sq. mm. there are about 18 to 23 zooecial apertures. The zooecia are separated by comparatively coarse vesicular tissue; there are one or two, rarely three, rows of vesicles between adjacent apertures, the vesicles ranging in diameter up to about 0·25 mm. At irregular and rather distant intervals the vesicles are aggregated to form spot-like maculae up to 2 mm. in diameter.

This species, which is readily recognized by its thin spreading unilaminate zoarium with maculae far less conspicuous than those of *Evactinopora trifoliata* and *Dichotrypa ? fragilis*, n. spp., is only one of several species of *Fistulipora* occurring in the Lower Burindi Series at Glen William and Hilldale; other species with distinct zooecial characters occur encrusting crinoid stems, etc., but are represented by specimens too poor for detailed description.

In the form of its zoarium this species closely resembles the genotype, *F. minor* M'Coy, 1850, from the Carboniferous of Derbyshire, but it differs in the details of its zooecial structure. *Fistulipora microscopica* Chapman, from the Burindi Series, Par. Moorowarra, near Somerton, had apparently a much thicker zoarium, and differed from this species in its much finer zooecial tubes and vesicular tissue.

Genus Dybowskiella Waagen and Wentzel, 1885.

Dybowskiella rhomboidea, n. sp. Text-fig. 32.

Holotype: 6426, Sydney Univ. Colln.

Horizon and locality: Upper Burindi Series, Taree Quarry in Por. 18, Par. Taree.

Laminar to small massive Dybowskiella; *lunaria strong, their ends indenting and projecting into the zooecial tubes; zooecia tubular, with few diaphragms, and separated by coarse vesicular tissue, which is replaced by dense tissue as the surface is approached.*

The zoaria are small irregularly shaped masses up to 1·5 cm. long, massive in appearance but actually built up of a number of laminae from 1 to 2 mm. or more in thickness; occasional laminae may extend some way beyond the edges of the main part of the colony. Small spot-like maculae about 1 × 1·5 mm. in diameter occur


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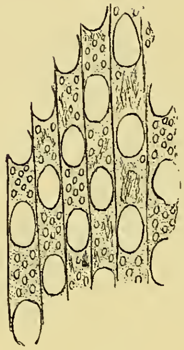
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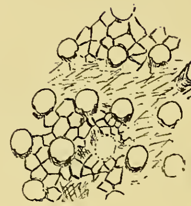
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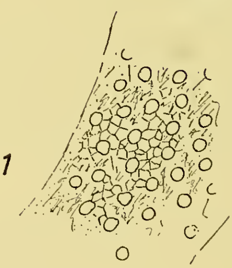
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Text-figs. 24-25.—*Streblotrypa parallela,* n. sp. 24. Surface and oblique fractured surface of part of the holotype, × 10. 25. Surface of the holotype, × 30.

Text-fig. 26.—*Fistulipora mirari,* n. sp. Weathered surface of part of the holotype, × 10. The zooecial tubes stand out slightly above the weathered vesicles so that part of their outer surface is shown.

Text-figs. 27-28.—*Dichotrypa fragilis,* n. sp. 27. Outline diagram of the holotype, × 1. 28. Part of an oblique weathered surface of the holotype, passing from the level of the mesial irregularly, these maculae being composed of vesicular tissue (or of solid tissue near the surface) and being surrounded by zooecial tubes larger than the average. In 7 sq. mm. there are about 23 zooecial apertures.

The zooecia are tubular; the lunaria are prominent and strongly developed, and they deeply indent the zooecial tubes, into which their ends project; the measurements of tubes of normal size are: *a*, 0·23 to 0·29 mm.; *b*, 0·28 to 0·35 mm. (usually more than 0·32 mm.); *c*, 0·11 to 0·14 mm.; *d*, 0·16 mm.; but zooecia of larger size are commonly found bordering the maculae. The lunaria occupy about one-third of the circumference of each tube and they are typically strongly thickened. An occasional thin complete diaphragm is developed in the zooecial tubes. The zooecia lie horizontal for a very short distance at the base of each lamina, and rapidly curve upwards to meet the surface almost at right angles. Comparatively coarse thin-walled vesicles separate the zooecia throughout the greater part of their length, and these vesicles are aggregated at intervals to form the maculae; two rows of these vesicles are found between adjacent zooecia, the line along which these two rows join being usually very distinct and thickened, giving a characteristic appearance to this form in tangential sections; it is to this apparent division of the zoarium into distinct rhombic areas that the specific name refers. As the surface is approached the vesicles are replaced by dense tissue, which occupies the spaces between the zooecia in the outer 0·25 to 0·8 mm. of each lamina.

The strong lunaria and the prominent thickening along the line of junction between the two rows of vesicles between adjacent zooecia readily distinguish this form from described species of the genus; it most closely resembles *D. crescentica*, n. sp., from Cannindah in Queensland, but differs in the slightly larger size of the zooecial tubes, the shape of the zooecia, and the structure of the vesicular tissue. Fragments of this species appear to be quite common in the limestone at the type locality, where it is associated with other fragmental Bryozoa (a species of *Fistulipora*, *Fistulamina* sp., etc.) in the matrix between and around the large compound coral *Aphrophyllum* cf. *hallense* Smith. The Taree limestone contains an Upper Viséan coral fauna.

Sub-family HEXAGONELLINAE, n. sub-fam.

Genus EVACTINOPORA Meek and Worthen, 1865.

EVACTINOPORA TRIFOLIATA, n. sp. Pl. iv, fig. 1; Text-figs. 30, 31.

Holotype: 6433, Sydney Univ. Colln.

Horizon and locality: Lower Burindi Series, Glen William.

Three-rayed Evactinopora; *rays very thin, bifoliate, surface with very elongate, depressed maculae; zooecia short, slightly indented by a thin lunarium, and separated by vesicular tissue.*

The zoarium is composed of three very thin vertical bifoliate rays, attached at their base to a *Spirifer*; the rays were placed at angles of approximately 150°, 110° and 100° to each other. The incomplete height of the rays at the centre of the zoarium is 2·2 cm.; their bases curve slightly downwards away from the centre along the *Spirifer*, and the maximum height shown is therefore greatest slightly away from the centre of the zoarium and is 2·7 cm.; the rays are up to 1·8 cm. wide at their widest point. Each ray is D-shaped in outline, and along their lower edges they are lightly attached to the *Spirifer* shell, and the bases of the rays appear to have spread very

lamina adjacent to a macula on the left-hand side to near the surface close to a macula on the right-hand side, × 10.

Text-fig. 29.—*"Batostomella" lineata*, n. sp. Surface of the holotype, × 10.

Text-figs. 30-31.—*Evactinopora trifoliata*, n. sp. 30. Outline diagram of two rays of the holotype, × 1. 31. Weathered surface of part of one ray adjoining two maculae, × 10.

Text-fig. 32.—*Dybowskiella rhomboidea*, n. sp. Oblique section through the holotype, × 10.

Text-figs. 33-36.—*Fistulamina inornata*, n. sp., × 10. 33. Oblique tangential section close to the surface of a topotype. 34. Oblique tangential section of a topotype passing from close to one surface at the lower end through to the mesial lamina and to the zooecia adjoining the mesial lamina on the other surface. 35. Transverse section of a topotype. 36. Vertical section of a topotype. (Slides in Sydney Univ. Colln.)

slightly over the surface of the shell; above this the rays are free. Long, slightly depressed maculae radiate from the base of the colony; these maculae are of strikingly large size, being from 5 to 10 mm. long and up to 2 mm. wide; they are also closely spaced, the distance between them being about 3 mm. longitudinally and 2·5 to 4 mm. transversely. These maculae apparently originally comprised a very thin layer of vesicular and solid tissue, now almost completely weathered away to leave a long oval space, but it is possible that they were originally spaces and, therefore, originally fenestrae rather than maculae.

The zooecial apertures are small and are slightly indented by a thin lunarium extending around about one-third of the circumference; the size of the zooecia is: *a*, 0·24–0·29 mm.; *b*, 0·2–0·27 mm.; *c*, 0·09–0·11 mm.; *d*, 0·14–0·16 mm. The zooecial tubes are very short indeed, being parallel to the mesial lamina for a short distance and then bending upwards to meet the surface rather obliquely. The interspaces between the zooecia are occupied by fine vesicles, one, rarely two, row of vesicles occurring between adjacent zooecia. The number of zooecia in 7 sq. mm. is 32 to 35.

This species appears to be an *Evactinopora* of very primitive type. The genus, which has hitherto been described only from the Burlington and Keokuk Groups of the Osage Series of the Mississippian of the United States, the Upper Viséan of Queensland and the Permian of Western Australia, comprises typically forms with four or more rays, which are free and typically have strong, comparatively thick rays, the surface being marked by small, solid maculae. This species possesses only three rays, these being extremely thin and fragile compared with those of other described species; however, although none of the species so far described has fewer than four rays, one undescribed species, occurring in the Permian of Western Australia, possesses only three very thin vertical rays, although in other ways it is a typical *Evactinopora*. This species also differs from other described species in being attached at its base (it is possible that *E. irregularis*, n. sp., may also have been an attached species); this indicates that it is a more primitive form than the free zoaria which developed later.

Genus Fistulamina, n. gen.

Genotype: *Fistulamina inornata*, n. sp.

Range: Carboniferous.

Zoarium bifoliate; branches ribbon-like, edges with narrow non-celluliferous margins; surface without maculae or hexagonellid ridges; internal structure fistuliporoid, lunaria present; interzooecial spaces in the central part of the zoarium occupied by vesicular tissue, which is replaced by dense tissue as the surface is approached.

This genus is proposed to include forms which closely resemble *Sulcoretepora* externally but whose internal structure is similar to that found in *Hexagonella*. In *Sulcoretepora*, ribbon-like bifoliate zoaria with the zooecial apertures usually arranged in distinct longitudinal ranges, frequently separated by parallel ridges, are developed; lunaria and hemisepta are commonly present; internally, the zooecia are semi-cordate in outline, and are arranged in longitudinal rows between vertical double plates; vesicular tissue is developed between the zooecia near the mesial lamina, but closer to the surface the zooecia are separated by dense tissue. In *Fistulamina*, however, although the external appearance of the zoarium is similar, the zooecia are separated near the mesial lamina by vesicular tissue, without any development of vertical plates between the rows of zooecia; the zooecia themselves are tubular instead of semi-cordate, show no development of hemisepta, and possess poorly-developed lunaria; this type of internal structure is therefore closely related to *Hexagonella* and is quite different from that shown in *Sulcoretepora*. *Fistulamina* differs from *Hexagonella*, however, in lacking the characteristic hexagonellid ridges developed in that genus and particularly in its lack of maculae; maculae are strongly developed in the broad frond-like species and in some of the ribbon-like species of *Hexagonella*, and in the ribbon-like species the edges of the branches are usually not parallel but are lobed, with the non-celluliferous border of the branch continued inwards as a small macula between the lobes; the zoaria of *Fistulamina* are also smaller and more flattened than those of *Hexagonella.*

Fistulamina inornata, n. sp., is a very common and characteristic form in the Lower Burindi and slightly younger rocks of New South Wales; a number of undescribed species congeneric with this form occur in the Burindi of New South Wales, in the Viséan at Mundubbera in Queensland, and also at Mt. Barney and other localities probably of Neerkol (Upper Carboniferous) age in Queensland. *Meekopora* ? *aperta* Ulrich, 1890 (p. 485), appears to be an American representative of this genus.

FISTULAMINA INORNATA, n. sp. Pl. iv, figs. 5–6; Text-figs. 33–36.

Holotype: 6431, Sydney Univ. Colln.

Horizon and locality: Lower Burindi Series, Glen William (holotype); Lower Burindi Series, Hilldale (7405, Sydney Univ. Colln.); marine intercalation near base of Lower Kuttung Series, Back Creek (7426, Sydney Univ. Colln.).

Zoaria narrow, bifoliate, ribbon-like; zooecial apertures small, with slight lunaria, arranged in 8 to 10 longitudinal rows and in diagonally intersecting rows on both sides of zoarium; zooecia tubular, separated by vesicular tissue near the mesial lamina, but by dense tissue as the surface is approached.

The zoarium consists of flattened bifoliate branches, 1·3 to 2·95 mm. wide, which bifurcate at fairly frequent intervals, generally between 0·6 and 1·5 cm.; bifurcation usually takes place in the plane of the mesial lamina. The branches are 0·5 to 0·7 mm. thick in the centre; both edges are rather blunt, the branches being elliptical in cross-section, and the non-poriferous margins of the branches are narrow and of about equal width on each side; a slight longitudinal ridge along each margin marks the position of the edges of the mesial lamina. The zooecial apertures are small and are rounded to very slightly oval; they are about 0·16 mm. in diameter. They are not indented by lunaria, and they are not surrounded by raised peristomes, although in thin sections slight lunaria can be distinguished. The apertures are usually arranged in 8 to 10 longitudinal rows on each surface, the number of rows being increased before bifurcation of the branches; they are also arranged in diagonally intersecting rows. There are about 19 apertures in each row in 10 mm., the distance between the centres of successive apertures being from 0·4 to 0·63 mm. The surface between the rows of apertures is smooth and finely granular; there are no longitudinal ridges between the rows of apertures.

The zooecia are short and tubular; they are placed back to back along the mesial lamina for a short distance and then bend outwards abruptly so that the vestibules meet the surface at right angles. In the central part of the zoarium near the mesial lamina the zooecia are separated by numerous small, thin-walled vesicles; close to the surface these are replaced by dense tissue. Neither hemisepta nor diaphragms are developed in the zooecial tubes.

Meekopora ? *aperta* Ulrich (1890, 485) shows a general resemblance to this species in its external appearance and internal structure, and should probably be referred to the same genus, though it is specifically distinct; *M.* ? *aperta* is from the Keokuk Group of Kentucky. Differences in size and in lunarial development readily distinguish *Fistulamina inornata* from *F. malmoensis* from the Viséan of Queensland. Species of *Sulcoretepora* which externally resemble this form are readily differentiated by differences in their internal structure.

Sub-family GONIOCLADIINAE Waagen and Pichl.

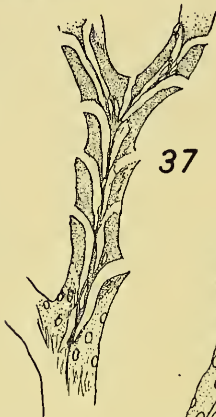
Genus GONIOCLADIA Etheridge, 1876.

Goniocladia Etheridge, 1876, 522; *Goniocladia* Etheridge, Bassler, 1929, 88; Moore, 1929, 154; Crockford, 1944, 157.

GONIOCLADIA LAXA de Koninck, 1878. Pl. v, figs. 3–5; Text-figs. 40, 41.

Retepora ? *laxa* de Koninck, 1878, 182, and 1892, 139; *Goniocladia laxa* de Koninck, Etheridge in Benson, 1921, 29.

Holotype: All of the specimens used by de Koninck were lost in a fire at the Garden Palace in Sydney in 1882; a neotype is not selected here as no topotype material is available.



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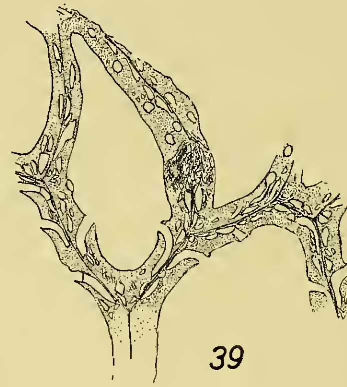

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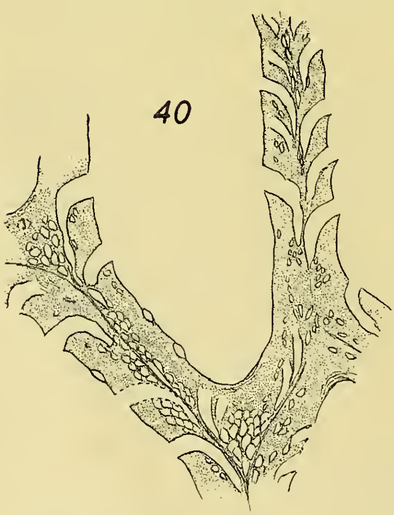

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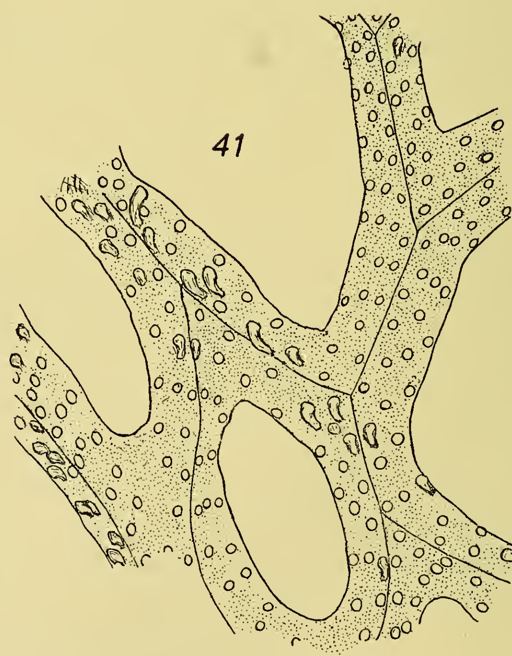

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Text-figs. 37-38.—*Ramipora* (*Ramiporalia*) *bifurcata*, n. sp., × 10. 37. Fractured section through a branch of the holotype. 38. Cast of part of the obverse surface of the holotype.

Text-fig. 39.—*Goniocladia parva*, n. sp. Fractured section through the holotype, × 10, the section being partly close to, and partly at, the obverse surface in the top central branch.

Text-figs. 40-41.—*Goniocladia laxa* (de Koninck), × 10. 40. Weathered section through part of a specimen from Hilldale (specimen figured on Pl. v, figs. 3, 4). 41. Cast of the obverse surface of a second specimen from Hilldale (specimen figured on Pl. v, fig. 5).

Horizon and locality: de Koninck's specimens were from "Colo Colo and Burragood", two Lower Burindi localities on the Allyn and Paterson Rivers. Benson (1913, 505) recorded but did not describe or figure this species, identified by Dun, from the Burindi Series at Crow Mountain, near Barraba. Etheridge, in an unpublished manuscript, states that he had specimens of this form from the Allyn River. The specimens which have been used for the revised description given here (specimens 5424, 5427 and 7411, Sydney Univ. Colln.) are from the Lower Burindi Series at Hilldale.

Coarse Goniocladia; *fenestrules large, irregularly polygonal; branches rather thin, sharply angular on the obverse and broadly rounded on the reverse surface, both surfaces being carinate; zooecial apertures in three, rarely more, rows on each side of the carina on the obverse surface; zooecia tubular, separated by fine vesicles close to the mesial lamina and by dense tissue closer to the surface.*

The zoarium is fenestrate; in spite of the large size of some of the specimens of this species—one incomplete specimen measured over 9 × 7 cm. and appears to be only a small part of a very large colony—none of the specimens used for this description show the form of the complete colony, which de Koninck stated was infundibuliform with the zooecial apertures placed on the outer surface of the branches. The zoarium forms a very coarse meshwork; the branches reticulate to form polygonal fenestrules of variable size; there are 1·5 to 2, rarely 2·5, fenestrules in 10 mm. longitudinally, and 2·5 to 4 fenestrules in the same distance transversely. The fenestrules vary in length from 2·0 to 8·3 mm., but are usually more than 4 mm. long; they are from 1 to 3·5 mm., generally between 2 and 3 mm., wide. The branches are from 0·63 to 1·5 mm., usually about 1·1 mm., wide. The non-celluliferous reverse surface of the branches, along the mid-line of which there is a fine ridge-like carina marking the position of the edges of the mesial lamina, is broad and smooth and only slightly convex; the obverse surface, however, is sharply carinate, and on each of its steeply sloping sides there are three, rarely four or five, rows of zooecial apertures. The apertures are round, about 0·22 mm. in diameter, and are surrounded by thin peristomes; these peristomes are most strongly developed on the row of apertures closest to the reverse surface, where they reach a height of up to 0·16 mm.

The mesial lamina runs from the centre of the reverse to the centre of the obverse surface; bifurcation of the branches takes place in a plane at right angles to that of the mesial lamina. The zooecia are tubular and are parallel to the mesial lamina for 0·75 to 1·0 mm., after which they bend outwards gradually to meet the surface obliquely. The zooecia are separated close to the mesial lamina by fine vesicular tissue, which is particularly strongly developed close to the reverse surface; the vesicles are replaced by dense tissue as the surface is approached, so that the interspaces are smooth and solid at the surface. Neither diaphragms nor hemisepta are developed.

This species is a smaller form than the genotype, *Goniocladia cellulifera* (Etheridge), from the Carboniferous of Scotland. *Goniocladia indica* Waagen and Pichl, 1885, from the Middle Productus Limestone of the Salt Ra., is of similar size to this species, but it differs in having broader branches, which are sharply carinate on the reverse and broadly rounded on the obverse surface, and in having very much coarser vesicular tissue, which apparently occupied a larger proportion of the interspaces than the vesicular tissue of *G. laxa*. *G. americana* Girty, 1908, from the Permian of Western Texas, has much stronger branches and differs in the appearance of the obverse and reverse surfaces. *G. grahamensis* Moore, 1929, from the Pennsylvanian of Texas, is a smaller species.

GONIOCLADIA PARVA, n. sp. Pl. v, fig. 2; Text-fig. 39.

Holotype: 8 on 7415, Sydney Univ. Colln.

Horizon and locality: Marine intercalation near the base of the Lower Kuttung Series, Rouchel Brook.

Fine Goniocladia; *fenestrules small, polygonal; branches thin, carinate on both obverse and reverse surfaces, the obverse surface being angular and the reverse rounded; zooecia in two rows on each side of the carina of the obverse surface; zooecia* *tubular, separated by fine vesicles near the mesial lamina, interapertural spaces solid at the surface.*

The zoarium is fenestrate, with comparatively fine meshes; the branches are 0·5 to 0·7 mm., but usually about 0·56 mm., in width, and they are irregularly reticulated to form polygonal fenestrules of comparatively small size for the genus—2·7 to 3·1 mm. long × 1·0 to 1·5 mm. wide. There are about 3 fenestrules longitudinally and 4 to 6 horizontally in 10 mm. Each of the specimens of this species was broken through more or less completely at about the level of the centre of the branches, and although they showed the internal structure clearly, the external structure was not very well shown, and the fine tuffaceous mudstone matrix adheres so firmly to the surface that it was not possible to break the matrix away to show the external structure more clearly. The branches were sharply convex on the obverse and rather rounded on the reverse surface, both surfaces being carinate. Two rows of zooecial apertures occur on each side of the carina on the obverse surface; of these, the lower row is rather strongly exserted; several of the apertures are indented by lunaria, which occupy one-third of the circumference on the lower side of the aperture—these are particularly well developed in the lower row of zooecia. The apertures are about 0·14 mm. in diameter; the distance between the centres of successive apertures is 0·46 to 0·7, generally less than 0·6 mm., and there is an average of 19 apertures in 10 mm. The surface between the apertures and on the reverse surface is smooth.

Internally, the fine mesial lamina runs from the centre of the reverse to the centre of the obverse surface; the zooecial tubes run parallel to the mesial lamina for about two-thirds of their length, and then bend outwards rather gradually to the surface; the total length of each tube is about 0·63 to 0·7 mm. Close to the mesial lamina the tubes are separated by vesicular tissue, this being particularly strongly developed close to the reverse surface; as the surface is approached, this vesicular tissue is replaced by dense tissue. Neither diaphragms nor hemisepta are developed.

This species is a much finer form than *Goniocladia laxa* de Koninck, which occurs on a lower stratigraphical horizon. It is also a finer form than any species of this genus so far described from the Russian Carboniferous. *Goniocladia grahamensis* Moore, 1929, from the Pennsylvanian Upper Graham formation of Texas, has fenestrules of similar size (about 2·8 × 1·5 mm.); the branches of this species are comparatively broader, with zooecia typically in 3 (they range from 2 to 4) rows on each side of the carina; the zooecial apertures are spaced 0·3 to 0·72 mm. apart, averaging approximately 22 in 10 mm., according to measurements taken on Moore's figures of this species; the apertures are without lunaria, and his figures also show longer zooecia, the most complete zooecia shown in his figured thin sections being up to 0·7 mm. in length along the mesial lamina, while those in *G. parva* are only up to 0·7 mm. in their total length. The differences between these two forms, and particularly in the number of rows of zooecia and size of the zooecia, indicate that they should be referred to different species.

Genus Ramipora Toula, 1875.

Sub-genus Ramiporalia Shulga-Nesterenko, 1933.

Ramiporalia Shulga-Nesterenko, 1933, 42, 59.

Genotype: *Ramipora* (*Ramiporalia*) *dichotoma* Shulga-Nesterenko, 1933.

Range: Carboniferous.

Ramipora (Ramiporalia) bifurcata, n. sp. Pl. v, fig. 1. Text-figs. 37, 38.

Holotype: 6429, Sydney Univ. Colln.

Horizon and locality: Lower Burindi Series, Glen William.

Ramiporalia *with regularly bifurcating bifoliate branches; branches carinate on both obverse and reverse surfaces, the obverse surface being angular and the reverse rounded; zooecial apertures in 3, less often 2, rows on each side of carina of obverse surface; zooecia separated by fine vesicular tissue close to the mesial lamina, interapertural spaces solid at the surface.*

The zoarium is composed of narrow bifoliate branches, 0·58 to 0·83 mm. in width and about 0·8 mm. in thickness along the mesial lamina; these branches bifurcate in a plane at right angles to the mesial lamina at frequent and regular intervals, usually between 2·7 and 3·5 mm. There is no sign of any anastomosis of branches of the colony. The mesial lamina, which runs from the centre of the obverse to the centre of the reverse surface, projects sharply above each surface to form a sharp ridge-like carina. Three, sometimes two, rows of zooecial apertures occur on each side of the carina of the obverse surface, which is more sharply convex than the reverse; the apertures are rounded to slightly oval, 0·17 to 0·22 mm. in diameter, the largest apertures occurring in the row of zooecia closest to the reverse surface; each aperture is surrounded by a thin, relatively high peristome. In 10 mm. there are about 18 apertures in each row, the distance between the centres of successive apertures being between 0·44 and 0·62 mm. The reverse surface is broadly rounded and is non-celluliferous; it appears to have been very coarsely granular. Internally, the zooecia lie parallel to the mesial lamina for about 0·7 mm., then they bend outwards to the surface. Close to the mesial lamina the zooecia are separated by numerous small vesicles, which are especially strongly developed close to the reverse surface; these vesicles are replaced by dense tissue as the surface is approached.

The mode of growth of this species and the greater number of rows of apertures distinguish it from *Goniocladia parva*, n. sp., which occurs in the overlying Lower Kuttung Series. An undescribed phylloporinid occurs associated with this species, but is distinguished by the fact that its branches, although regularly bifurcating, are unilaminar and not bifoliate, and that they are without carinae on either the obverse or reverse surfaces; the material of this phylloporinid is too poor for detailed description. From *Ramipora* (*Ramiporalia*) *dichotoma* Shulga-Nesterenko, 1933, which has a similar growth form, this Burindi species is readily distinguished by its different measurements.

Material from this and other localities in the Lower Carboniferous of New South Wales very frequently contains fragmentary specimens of species of *Ramipora*, too poorly preserved for detailed description.

Order Trepostomata Ulrich.

Family Batostomellidae Ulrich.

Genus Batostomella Ulrich, 1882.

Batostomella (pars), Ulrich, 1882, 141, 154; *Batostomella* (pars), Ulrich, Ulrich, 1890, 375, 432; *Batostomella* Ulrich, Bassler, 1929, 60.

"*Zoarium ramose, branches slender; zooecia with few diaphragms; apertures of zooecia small, circular or oval; interspaces rounded or canaliculate, spinulose, the acanthopores small and usually very numerous; mesopores small, with sub-circular openings.*" (Nickles and Bassler, 1900, 32.)

Genotype: *Batostomella gracilis* (Nicholson), 1874.

Range: Ordovician (?) to Permian.

The validity of this generic name is doubtful. In his original description of this genus, Ulrich included four species and one variety (listed by him under the names of *Chaetetes granuliferus* Ulrich, *C. gracilis* James, *Trematopora annulifera* Whitfield, and *M.* (*Calamopora*) *tumida* Phillips, and var. *miliaria* Nicholson) and also stated that three undescribed species, of which he knew, should be referred here. Of the described species, the first three were from the Ordovician and the others from the Carboniferous; Ulrich did not name any one of these species as genotype in his original description (1882, 154) or discussion (1882, 141) of this genus. In 1890 Ulrich again published a diagnosis of this genus; in this he states that the "types" are "*B. spinulosa* n. sp. and *B. gracilis* Nicholson"; *B. gracilis* Nicholson is *Chaetetes gracilis* James of Ulrich's earlier list of species belonging to this genus, the name having been first used by James in manuscript and later published by Nicholson. Later authors have almost universally quoted *Batostomella spinulosa* as the genotype of *Batostomella*, but since this is not one of the species originally referred to the genus by Ulrich (unfortunately

Ulrich does not state in his description in 1890 whether *B. spinulosa* was one of the "undescribed species" he earlier referred to *Batostomella* or not) this course is inadmissible. The genotype is therefore *Chaetetes gracilis* Nicholson, which has long been removed from *Batostomella* and placed in *Bythopora* Miller and Dyer, 1878; if this classification of *Chaetetes gracilis* be correct (I have not access to any description of the genotype of *Bythopora* for comparison), *Batostomella* must be considered a synonym of *Bythopora*.

According to Bassler (1934, 54) two other generic names are available to replace *Batostomella*; these are *Geinitzella* Waagen and Wentzel, 1886, and *Batostomellina* Vinassa de Regny, 1920.

The status of *Geinitzella* is extremely involved; Waagen and Wentzel referred two species to the genus, as *Geinitzella columnaris* (Schlotheim) and *G. crassa* (Lonsdale); in their lengthy synonymy of *G. columnaris* they included as synonyms a large number of earlier described species, and in their description they recognize four varieties of this species; of these, Lee (1912, 152) has selected the variety they figured as *Geinitzella columnaris* var. *incrustans* (Geinitz) as genotype. While most of the figures of *Geinitzella* given by Waagen and Wentzel have been regarded as showing that his genus is a synonym of *Batostomella*, this does not apply, as Bassler (1929) has already pointed out, to *G. columnaris* var. *incrustans*; this particular variety, of which only two longitudinal sections are figured, should apparently be referred either to *Dyscritella* or *Stenopora*—no diaphragms are shown in any of the tubes cut in the figured sections, and in places the walls are irregularly thickened so as to suggest slight beading, so that this species is probably a *Stenopora*. Hence, since Lee's designation of *Geinitzella columnaris* var. *incrustans* as genotype must be accepted, the generic name *Geinitzella* is not available to replace *Batostomella*.

The second synonym of *Batostomella* listed by Bassler is *Batostomellina* Vinassa de Regny, 1920. The genotype of this genus is *Trematopora granulifera* Hall, 1852, from the Rochester Shale of New York; this species has been revised by Bassler (1906, 28). The original diagnosis of this genus by Vinassa de Regny is "*Batostomella* tabulis nullis"; the type species certainly is without tabulae, and therefore substitution of the name *Batostomellina* for *Batostomella* is not possible; *Batostomellina* may be a synonym of *Dyscritella*, but this is not certain, since revision of many batostomellids has revealed significant differences in wall structures, etc., between earlier and later Palaeozoic forms (Duncan, 1936).

A new name is therefore necessary for this genus of bryozoans, and consequently also for the family Batostomellidae, unless application is made for suspension of the Rules of Nomenclature. This procedure is best left until it can be based upon a comprehensive revision of the genera whose status is involved in this question.

"BATOSTOMELLA" LINEATA, n. sp. Text-fig. 29.

Holotype: F.42112D, Australian Museum Colln.

Horizon and locality: Burindi Series, near Barrington House, Williams River, Barrington Tops.

Fine "Batostomella"; *acanthopores small, numerous; mesopores developed at the angles of the apertures; zooecial apertures oval and comparatively large.*

The zoarium is ramose; the branches are cylindrical, 1·18 to 1·36 mm. in width; no maculae appear to have been developed. The apertures are oval to almost round, from 0·19 to 0·24 mm. × 0·13 to 0·19 mm. in diameter; they are arranged in irregular diagonal rows. In 1 mm. longitudinally there are about 3 zooecial apertures; the interspaces between the apertures are rounded and bear numerous tiny, blunt, spine-like acanthopores, which are usually almost worn off so that only their bases remain, but which when they are well preserved may project up to 0·02 mm. above the surface of the zoarium; these acanthopores appear to have all been of the same size. Small rounded to oval mesopores, up to about 0·1 mm. in diameter, occur usually at each angle of the apertures, so that about five occur around each aperture. The interspaces between the zooecia are from 0·05 to 0·1 mm. wide transversely and up to 0·22 mm. thick longitudinally.

The cortical zone occupies about one-fifth to one-quarter of the radius of the zoarium, its width being 0·24 to 0·32 mm. The zooecia are tubular, and bend from the axial zone (where they are very thin walled) to the cortical zone at an angle of about 60°; the walls are abruptly thickened in the cortical zone, giving the broad solid interspaces shown at the surface. A single thin complete diaphragm occurs in some tubes just within the bend in the zooecial tubes.

This species is a typical member of the group of forms congeneric with *B. spinulosa* (Ulrich).

Order Cryptostomata Vine.
Family Fenestrellinidae Bassler.
Genus Fenestrellina d'Orbigny, 1849.

Fenestrellina d'Orbigny, 1849, 501; *Fenestrellina* d'Orbigny, Bassler, 1935, 111. Homonym: *Fenestella* Lonsdale, 1839.

Fenestrellina propinqua (de Koninck), 1877. Pl. vi, fig. 4; Text-fig. 50.

Fenestella propinqua de Koninck, 1877, 174, Pl. viii, fig. 3 (1898, 133, Pl. viii, fig. 3); *Fenestella propinqua* de Koninck, Benson, 1921, 27; [non] *F. ampla* ? Dana (a Permian form referred to this species by de Koninck).

Neotype: 2403, Sydney Univ. Colln. (de Koninck's type specimens formed part of the collections made by Rev. W. B. Clarke; on being returned to Australia, these specimens were exhibited in the Garden Palace, which was burnt in 1882.)

Horizon and locality: Lower Burindi Series, Glen William (original locality of de Koninck's specimens and locality of neotype chosen here); Lower Burindi Series, Hilldale (specimens 7401, 7406, 7412, Sydney Univ. Colln.); marine intercalation near base of Lower Kuttung Series, Back Creek (specimen 7426, Sydney Univ. Colln.); Burindi Series, Barrington House, Williams R., Barrington Tops (F.42112F, Australian Museum Colln.).

Coarse Fenestrellina; *branches thin, fenestrules large and irregularly rectangular; zooecia in two rows, with usually 6 to 7 zooecia to a fenestrule; slight carina with a single row of very small nodes.*

The zoarium is fenestrate; de Koninck states that the colony was funnel-shaped and implies that the inner surface was celluliferous. There are 10 to 11 branches and 4 to 5 fenestrules in 10 mm. The branches are thin, 0·21 to 0·35 mm. wide, and are fairly straight; in some parts of a specimen they may branch within 2 or 3 fenestrules, but at times the bifurcations may become very distant. There are two rows of small round zooecial apertures, 0·08 mm. in diameter, and surrounded by thin, distinct peristomes; increase to three rows of apertures occurs only immediately before bifurcation; the two rows of apertures are separated by a very faint carina, which bears a single row of very small nodes; the spacing of these nodes is unfortunately not well shown, but appears to have been about 0·42 mm. apart. There are usually 6 or 7 apertures to a fenestrule, the number ranging from 5½ to 10, with occasionally abnormally short or long fenestrules with fewer or more zooecia; the distance between the centres of successive apertures is between 0·27 and 0·36 mm., and there are about 32 apertures in 10 mm. The fenestrules are irregularly rectangular in outline; they are generally from 1·5 to 2·7 mm. long, but a few fenestrules may be abnormally short or long. The dissepiments are 0·06 to 0·4 mm. wide. The dissepiments are depressed below the level of the branches on the obverse surface, and on this surface they bear a strong carina; on the reverse they are of about the same thickness as the branches, and both are smooth and evenly rounded. The zooecia are ovoid in shape.

The neotype and other specimens used in this description compare closely with de Koninck's original description and figures of specimens from Glen William; this form has a very characteristic appearance (Pl. vi, fig. 4), and is a common and easily identified form in the Burindi of New South Wales. De Koninck considered this form the same as a species figured by Dana in 1849 from the Permian at Glendon as "*Fenestella ampla* ?"; Dana's species is quite unrecognizable from his figures and brief description, and it is unlikely that the species he figured was *F. propinqua*. *F. propinqua* has also been recorded without descriptions or figures by a number of more recent workers from localities in the Upper Marine Series of the Hunter River district and the Macleay Series of the Macleay River district of New South Wales and also from the Lyons Series of the North-West Basin in Western Australia (see Raggatt and Fletcher, 1937, 172); it is most improbable that any of these records refer to the occurrence of de Koninck's species.

In one or two of the specimens used for this description there is a tendency for one of the branches to bifurcate more rapidly than the others and so to give a slightly pinnate appearance to part of the zoarium; this pinnate appearance slightly developed is common in several of the Burindi fenestellids, and one species of this type was recorded as "*Fenestella gracilis* ? J. D. Dana" by de Koninck from Burragood, a Burindi locality on the Paterson River; it is not possible to recognize this species from de Koninck's description (the specimens are not figured). *F. gracilis* Dana, 1849, is from a Permian locality, and is also unrecognizable. *Ptilopora* and *Penniretepora* occur quite commonly in the Lower Burindi and Lower Kuttung Series, and it is therefore interesting to find this slight tendency towards pinnate growth in some of the associated fenestellids.

FENESTRELLINA ACARINATA, n. sp. Pl. vi, fig. 3; Text-fig. 45.

Holotype: 7402, Sydney Univ. Colln.

Horizon and locality: Lower Burindi Series, Hilldale (holotype); Lower Burindi Series, Glen William (specimen 6438, Sydney Univ. Colln.).

Fine Fenestrellina; *branches straight to slightly sinuous, carina and nodes absent; zooecial apertures strongly exserted, in two rows, 3 to 4 zooecia to a fenestrule.*

The zoarium is infundibuliform, the internal surface being celluliferous; in 10 mm. there are 10 to 11, rarely 13, fenestrules, and 19 to 24 branches. The branches are straight, 0·21 to 0·32 mm. wide; the zooecial apertures are in two rows, and no carina is shown, the centre of the branches on the obverse surface being slightly depressed and ornamented by a few faint discontinuous longitudinal striae; no nodes are developed. The apertures are small and round, 0·08 mm. in diameter, and they are very strongly exserted, being almost stalked in appearance; there are 3 to 4 apertures to a fenestrule, and about 40 in 10 mm., the distance between the centres of successive apertures being 0·22 to 0·32 mm. The fenestrules are oval, 0·55 to 0·87 mm. (generally between 0·68 and 0·82 mm.) long and 0·2 to 0·4 mm. wide; the width of the dissepiments is 0·1 to 0·21 mm., and the length of one fenestrule and one dissepiment 0·71 to 1·0 mm. The zooecial cells are ovoid in outline; where the specimens have been slightly weathered their shape is well shown in casts, and marked inferior hemisepta are developed in the zooecia; on the surface of the branches, and placed adjacent to the apertures, swollen surface cells the same as those occurring in some of the Permian Fenestellidae in New South Wales are occasionally developed. On the obverse surface the dissepiments are rounded and are placed at the same level as the branches, but they are depressed below the level of the branches on the reverse surface; the backs of the cells are covered on the reverse surface by only a very thin layer of calcium carbonate, showing longitudinal striae close to the backs of the cells and being finely granular at the surface.

This fine species is somewhat similar in size to the associated *Hemitrypa clarkei*, n. sp., but an examination of the details of their appearance readily serves to distinguish these two species from each other.

FENESTRELLINA CRIBRIFORMIS, n. sp. Text-fig. 48.

Holotype: 7415A, Sydney Univ. Colln.

Horizon and locality: Marine intercalation near the base of the Lower Kuttung Series, Rouchel Brook.

Fenestrellina *with very thin branches; 3 to 5 zooecia to a fenestrule.*

There are 8 to 11 fenestrules and 18 to 21 branches in 10 mm. The branches are very thin, 0·19 to 0·3 mm. wide, and are straight, branching at only very distant intervals; they bear two rows of small zooecial apertures, placed on either side of a slight median carina; on this carina small nodes are developed at distant intervals, but these are readily worn away and unfortunately are not well shown in any of the specimens examined. The apertures, which are strongly exserted, are round and 0·09 mm. in diameter; there are 3 to 5 apertures to a fenestrule and about 36 in 10 mm., the distance between the centres of successive apertures being 0·22 to 0·34 mm.; increase to three rows of zooecia occurs only immediately before bifurcation. The fenestrules are rectangular in outline, 0·71 to 1·28 mm. long and about 0·2 to 0·55 mm. wide; the dissepiments are 0·06 to 0·13 mm. wide and are very much thinner than the branches. The zooecia are ovoid to rhomboidal in shape. The reverse surface of the branches is smooth and evenly rounded.

This species is a larger form and is distinguished by the spacing of its zooecial apertures and by the appearance of the obverse surface from *Hemitrypa clarkei* and *Fenestrellina acarinata*, which occur on a lower stratigraphical horizon.

FENESTRELLINA ROUCHELI, n. sp. Text-fig. 49.

Holotype: 7414 and 7415B (reverse), Sydney Univ. Colln.

Horizon and locality: Marine intercalation near the base of the Lower Kuttung Series, Rouchel Brook.

Fenestrellina *with 4 to 7 zooecia to a fenestrule; carina slight, nodes not developed.*

The zoarium is fenestrate; in 10 mm. there are 13 to 17 branches and 5 to 7 fenestrules. The branches are comparatively broad, 0·24 to 0·36 mm. in width, and they bear two rows of zooecial apertures, placed on either side of a very slight carina; no nodes appear to be developed. Bifurcation of the branches occurs at infrequent intervals, and increase to three rows of zooecia occurs only immediately before bifurcation. The apertures are round, 0·09 mm. in diameter, and they are not very strongly exserted; there are 4 to 7 apertures to a fenestrule, and 33 in 10 mm., the distance between the centres of successive apertures being 0·24 to 0·38 mm. The fenestrules are oval to almost rectangular in outline, and are from 1·0 to 2·25 mm. long and 0·2 to 0·6 mm. wide; the width of the dissepiments is 0·11 to 0·32 mm., and the total length of one fenestrule and one dissepiment is 1·1 to 2·37 mm. The reverse surface of both branches and dissepiments is smooth and evenly rounded, the branches being considerably thicker than the dissepiments.

The finer zoarium, with a smaller number of zooecia to a fenestrule, and the relatively thicker branches, distinguish this species from *F. propinqua* (de Koninck).

FENESTRELLINA BARRINGTONENSIS, n. sp. Text-figs. 42, 43.

Holotype: F.42112G, Australian Museum Colln.

Horizon and locality: Burindi Series, near Barrington House, Williams River, Barrington Tops.

Very fine Fenestrellina; *two zooecia to a fenestrule; slight carina with small, sharp, closely-spaced nodes.*

The zoarium is fenestrate and is very fine meshed, there being about 22 fenestrules and 30 to 32 branches in 10 mm. The branches are straight and are very thin, 0·15 to 0·19 mm. in width; they bifurcate comparatively frequently, often within four or five fenestrules. There are two rows of zooecial apertures, increasing to three only immediately before bifurcation; a slight ridge-like median carina is developed, and this bears a single row of small sharp nodes, spaced 0·16 to 0·25 mm. apart, with about 50 in 10 mm. The zooecial apertures are extremely small, being only about 0·05 mm. in diameter; they are surrounded by slight but distinct peristomes. There are two apertures to a fenestrule, these being so placed that one occurs at the end of each dissepiment and the other at the centre of each fenestrule; the distance between the centres of successive apertures is 0·19 to 0·24 mm., and there are about 46 apertures in 10 mm. The fenestrules are oval, 0·38 to 0·48 mm. long and 0·12 to 0·19 mm. wide;

the width of the dissepiments is from 0·03 to 0·08 mm., and the total length of one fenestrule and one dissepiment is from 0·42 to 0·52 mm.

FENESTRELLINA CELLULOSA, n. sp. Text-fig. 44.

Holotype: F.42113H, Australian Museum Colln.

Horizon and locality: Burindi Series, Barrington House, Williams River, Barrington Tops.

Fine Fenestrellina, *with three to four zooecia to a fenestrule; carina slight, nodes small, sharp, and closely spaced; cells rhomboidal in shape.*

The zoarium is fenestrate; in 10 mm. there are about 24 to 30 branches and 13 to 14 fenestrules. The branches are thin and straight, bifurcating only at distant intervals; they are about 0·2 mm. in width, and bear two rows of zooecial apertures, separated by a slight, low but distinct carina, on which there is a single row of small, sharp nodes; these nodes are spaced 0·19 to 0·24 mm. apart, there being about 47 nodes in 10 mm. The zooecial apertures are rounded, about 0·12 mm. in diameter, and they are surrounded by thin distinct peristomes; there are three to four apertures in the length of one fenestrule and one dissepiment, and about 44 in 10 mm., the distance between the centres of successive apertures being 0·2 to 0·24 mm. The fenestrules are oval to rectangular in outline, and are usually between 0·61 and 0·71 mm. long and 0·15 to 0·22 mm. wide; the dissepiments are 0·06 to 0·12 mm. wide. On the reverse surface both branches and dissepiments are smooth and are evenly rounded, the dissepiments being depressed below the level of the branches. The cells are rhomboidal in outline on the basal plate.

This species is of especial interest because of the shape of its cells, which are similar in outline to the cell shape found in the great majority of Permian species in New South Wales.

Genus HEMITRYPA Phillips, 1841.

Hemitrypa Phillips, 1841, 27; *Hemitrypa* Phillips, Ulrich, 1890, 396, 559; Nikiforova, 1933, 30, 55.

"*Zoaria funnel-shaped or undulating foliar expansions; branches rigid. Zooecia in two ranges, their apertures separated by a moderately developed keel. The latter is elevated at regular intervals into small pillars, which, when the superstructure they support is worn away, appear as spine-like prominences. The superstructure consists of straight or zig-zag longitudinal bars, of which one is placed over each branch upon the row of pillars and another, usually somewhat thinner, suspended midway between the branches. These bars are then connected by transverse processes, so as to leave regular, small, generally hexagonal openings, corresponding in number and position with the zooecial apertures beneath them.*" (Ulrich, 1890, 396.)

Genotype: *Hemitrypa oculata* Phillips, 1841.

Range: Devonian to Carboniferous, ? Permian.

The only previous record of the occurrence of this distinctive genus in Australia was made by Lonsdale, who in 1844 described, and in 1845 figured, one species, *Hemitrypa sexangula* Lonsdale, 1844, from the Permian of southern Tasmania; no later description or fresh record of the occurrence of this species has since been made, and Lonsdale's specimens, which formed part of Darwin's collection of fossils from Australia, have long been lost. A second species of this interesting genus occurs in Devonian strata in a railway cutting near Lake Bathurst, New South Wales (specimens F.30170, 30175, Australian Museum Colln.).

HEMITRYPA CLARKEI, n. sp. Pl. vi, figs. 1, 2. Text-fig. 46.

Holotype: 6430, Sydney Univ. Colln.

Horizon and locality: Lower Burindi Series, Glen William (holotype); Lower Burindi Series, Hilldale (specimens 7405, 7410, Sydney Univ. Colln.).

Hemitrypa *with fenestrate part fine meshed; 2·5 zooecia to a fenestrule; carina sharp, with nodes which support the superstructure developed at frequent intervals; superstructure a thin regular hexagonal meshwork.*

The shape of the colony is not shown in any of the specimens examined, although some of them are expansions of considerable size; the fenestrate mesh is fine and very regular, there being 20 to 24 branches, and 14 to 17, but generally 15 or 16, fenestrules in 10 mm. The branches are straight, 0·24 to 0·3 mm. wide; they bear two rows of zooecial apertures, separated by a slight median carina, which is produced at intervals of 0·29 to 0·55 mm., but usually about 0·38 to 0·46 mm., into sharp, high nodes; there are about 24 of these nodes in 10 mm.; they slant slightly forwards, and they serve to support the superstructure. The zooecial apertures are rounded and comparatively rather large, being about 0·1 mm. in diameter, and they are surrounded by slight peristomes. There are 2·5 apertures to a fenestrule and 40 in 10 mm., the distance between the centres of successive apertures being 0·21 to 0·3 mm. The fenestrules typically appear rectangular in outline, although from the reverse surface, when the fenestrules are infilled with sediment, they may appear rounded; the length of one fenestrule and one dissepiment is 0·52 to 0·75 mm.; the length of the fenestrules is 0·32 to 0·59 mm., and the width of the dissepiments 0·1 to 0·24 mm., these last two measurements, as usual, varying in a complementary fashion with the level at which measurement is made; the dissepiments are wider and the fenestrules therefore shorter about the middle of the branch. On the obverse surface the dissepiments are depressed slightly below the level of the branches. On the reverse surface the branches and dissepiments are of about the same thickness, and both are evenly rounded and coarsely granular. The thickness of the branches is about 0·36 to 0·4 mm. The superstructure is raised 0·19 to 0·32 mm. above the surface of the branches; it consists of a regular hexagonal mesh, the spaces in which are about 0·22 mm. in diameter, and the solid bars or scalae about 0·02 mm. thick. Transversely the number of longitudinal bars is double the number of branches in the same distance, and the bars placed above the branches (principal bars) are very slightly, but distinctly, thicker than those placed between them (secondary bars). Longitudinally the spaces in the hexagonal meshwork correspond in number and position to the apertures beneath.

Of described species of *Hemitrypa*, *H. proutana* Ulrich, 1890, from the Keokuk and Warsaw Beds of the Mississippian, is a similar species, but differs in its less regularly hexagonal mesh and in its slightly smaller size—there are 26 branches and 18 to 19 fenestrules, and 46 to 48 zooecia, in 10 mm. in Ulrich's species. *H. plumosa* (Prout), 1858, has 13 to 15 fenestrules in 10 mm., but has more closely spaced nodes and zooecia than *H. clarkei*. In Russia, *Hemitrypa* has so far been described only from the Lower Carboniferous.

Family ACANTHOCLADIIDAE Zittel.

Genus PTILOPORA M'Coy, 1845.

Ptilopora M'Coy, 1845, 200; *Ptilopora* M'Coy, Ulrich, 1890, 398, 621.

"*Zoaria pinnate, the median branch stronger, particularly on the reverse, than the oblique lateral branches. The latter are united to each other at frequent intervals by non-poriferous dissepiments. Zooecia in two ranges.*" (Ulrich, 1890, 398.)

Genotype: *Ptilopora pluma* M'Coy, 1845.

Range: Devonian to Permian.

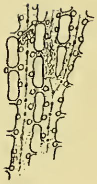
PTILOPORA KONINCKI, n. sp. Pl. vi, fig. 5; Text-fig. 51.

Holotype: 6441, Sydney Univ. Colln.

Horizon and locality: Lower Burindi Series, Glen William (holotype); marine intercalation near base of Lower Kuttung Series, Rouchel Brook (7417, Sydney Univ. Colln.).

Ptilopora *with 3 to 5 zooecia to a fenestrule; carina slight, nodes small, sharp, spaced about the same distance apart as the zooecial apertures; zooecia triangular in outline, with strongly-developed inferior hemisepta.*

The zoarium is pinnate; the largest colony observed (from Rouchel Brook) is about 3·5 × 2·5 cm. The midrib is slightly, but distinctly, thicker than the lateral branches, being up to 0·4 mm. wide; the lateral branches are 0·16 to 0·32 mm. wide,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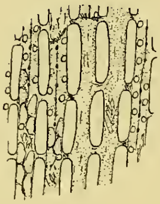
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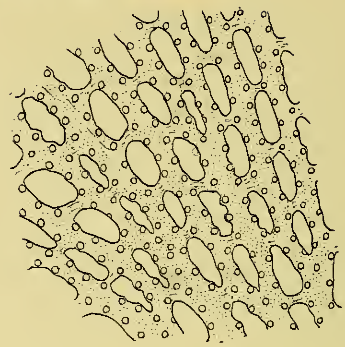
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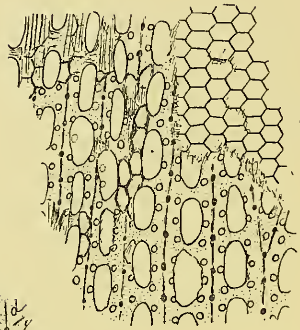
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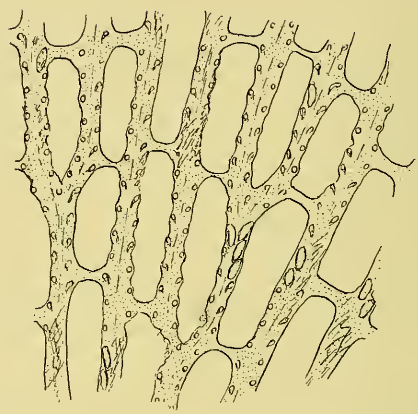
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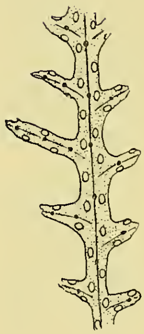
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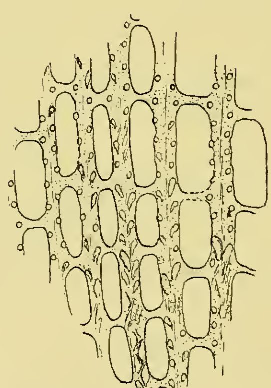
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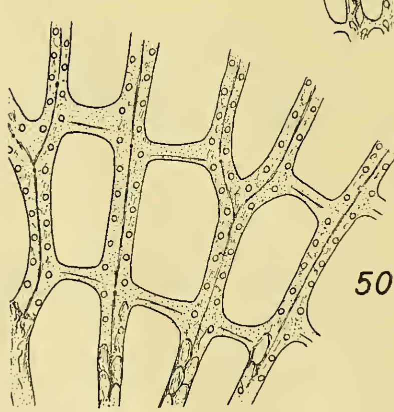
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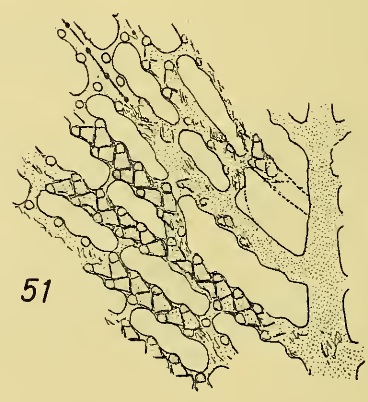
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Text-figs. 42-43.—*Fenestrellina barringtonensis*, n. sp., × 10. 42. Cast of the obverse surface of the holotype. 43. Weathered surface of the holotype, showing the shape of the cells.

Text-fig. 44.—*Fenestrellina cellulosa*, n. sp. Part of the holotype, showing the reverse surface, partly weathered to show the backs of the cells and to show a cast of part of the reverse surface. × 10.

and they alternate irregularly; they are given off at an angle which varies greatly even in the same specimen, usually between 25° and 55°; a few of the lateral branches themselves become pinnate. There are about 9 lateral branches given off on each side of the midrib in 10 mm.; the distance between the points of origin of successive lateral branches is rather variable, being between 0·8 and 2·3 mm. The lateral branches are connected at intervals by non-poriferous dissepiments, the length of the fenestrules so formed being usually between 0·93 and 1·35 mm., although very short fenestrules about 0·3 mm. long are occasionally developed; the width of the dissepiments is 0·07 to 0·28 mm. Both midrib and lateral branches bear two rows of zooecial apertures, separated by a slight carina; a single row of small, sharp nodes, their spacing about the same as that of the zooecial apertures, occur on this carina. There are usually 3 to 4, sometimes 5, zooecia to a fenestrule, but up to 7 occur along the longer side of the fenestrule adjoining the midrib. The zooecial apertures are circular, 0·08 to 0·11 mm. in diameter, and they often project rather strongly into the fenestrules; there are 29 apertures in 10 mm., the distance between the centres of successive apertures being 0·31 to 0·38 mm. The zooecia themselves are triangular in outline, with strongly developed inferior hemisepta, which are prominent where the reverse of the zoarium has been weathered or broken away and the backs of the zooecia revealed. The reverse surface of the branches is rounded and finely granular.

De Koninck (1877, 169, 170; 1898, 130) described *Dendricopora hardyi* as a new genus and species of pinnate bryozoan from the Carboniferous at Burragood on the Paterson River; his two figures of this species, both natural size, show that it was a much coarser form than *P. konincki*, and according to his description, the midribs and branches showed three rows of zooecia, and there were 10 to 11 zooecia to a fenestrule. *Dendricopora* has usually been listed as a synonym of *Ptilopora*, but if de Koninck was correct in stating that it possessed three rows of zooecia, it is distinct. Prantl (1934, 1935, according to *Zoological Record*, 1936) has recorded species of *Dendricopora* from the Carboniferous of Bohemia.

Fragments of pinnate zoaria are common in the Lower Carboniferous of the northern Hunter River district, and especially at Rouchel Brook; the majority of these appear to be broken pieces of *Ptilopora*, and at least one species besides *P. konincki* occurs at Rouchel Brook; this species is known from a number of specimens which are poorly preserved, but which show that the zooecia were long, narrow and oval, almost rectangular, in outline, lying in two parallel rows along each branch, and quite different in shape to the triangular zooecia of *P. konincki*.

P. konincki is abundant at Rouchel Brook and less common at Glen William, but a specimen from the latter locality was selected as the type as it is much the best preserved specimen examined; in all the material from Rouchel Brook recrystallization of the calcium carbonate of the zoarium has partially obscured the structure.

Genus Penniretepora d'Orbigny, 1849.

Penniretepora d'Orbigny, 1849, 501; *Penniretepora* d'Orbigny, Bassler, 1935, 20, 165; Crockford, 1942, 110; synonyms: *Pinnatopora* Vine, 1884; *Glauconome* Auct. (not Goldfuss, 1826).

Text-fig. 45.—*Fenestrellina acarinata*, n. sp. Part of the obverse surface of the holotype, × 10.

Text-fig. 46.—*Hemitrypa clarkei*, n. sp. Part of the holotype, weathered from the reverse surface to show the backs of the cells, a cast of the obverse surface, and the hexagonal meshwork which overlies the obverse surface, × 10.

Text-fig. 47.—*Penniretepora osbornei*, n. sp. Cast of part of the obverse surface of the holotype, × 10.

Text-fig. 48.—*Fenestrellina cribriformis*, n. sp. Weathered surface of part of the holotype, × 10.

Text-fig. 49.—*Fenestrellina roucheli*, n. sp. Weathered surface of part of the holotype, × 10.

Text-fig. 50.—*Fenestrellina propinqua* (de Koninck). Part of the neotype, weathered from the reverse surface to show the backs of the cells and a cast of the obverse surface, × 10.

Text-fig. 51.—*Ptilopora konincki*, n. sp. Part of the holotype, weathered from the reverse surface to show the backs of the cells and a cast of the obverse surface, × 10.

PENNIRETEPORA OSBORNEI, n. sp. Text-fig. 47.

Holotype: 6428, Sydney Univ. Colln.

Horizon and locality: Lower Burindi Series, Glen William.

Penniretepora *with two zooecia between the origins of successive lateral branches; strong carina with sharp, widely spaced nodes.*

The zoarium is pinnate; the width of the midrib is 0·24 to 0·3 mm., and lateral branches, 0·14 to 0·24 mm. in width, are given off almost opposite at angles of 60° to 70°. The lateral branches are given off at rather regular intervals, 0·68 to 0·8, but usually about 0·72 mm., and there are about 14 in 10 mm. There are two rows of zooecial apertures separated by a strong median carina on both midrib and lateral branches; the carina bears a single row of small sharp nodes spaced 0·57 to 0·67 mm. apart on the midrib and two-thirds of this distance apart on the lateral branches. The apertures are oval, 0·15 × 0·1 mm. in diameter, and are surrounded by slight peristomes; they do not project so as to give the edges of the branch a serrated appearance. The distance between the centres of successive apertures is 0·34 to 0·37 mm., and there are about 28 apertures in 10 mm., there being two apertures between the points of origin of successive lateral branches on each side of the midrib. The reverse surface of the zoarium was rounded and finely granular.

This form is differentiated by its much more closely spaced lateral branches, by the higher carina and more widely spaced nodes, as well as by the lack of dissepiments, from *Ptilopora konincki*, n. sp., with which it is associated at Glen William.

Family RHABDOMESONTIDAE Vine.

Genus STREBLOTRYPA Ulrich, 1890.

Streblotrypa Ulrich, 1890, 403, 665; *Streblotrypa* Ulrich, Bassler, 1929, 66; Crockford, 1944, 168.

STREBLOTRYPA PARALLELA, n. sp. Pl. iv, fig. 3; Text-figs. 24, 25.

Holotype: 7400, Sydney Univ. Colln.

Horizon and locality: Lower Burindi Series, Hilldale (holotype); Lower Burindi Series, Glen William (6437, Sydney Univ. Colln.); Burindi Series, near Barrington House, Williams River, Barrington Tops (F.42112, Australian Museum Colln.); Lower Kuttung Series, Rouchel Brook (7416, Sydney Univ. Colln.).

Fine Streblotrypa, *with about 15 rows of zooecia; eight small mesopore-like pits in the area behind each aperture; zooecia short, arising from an imaginary axis along the centre of the branch.*

The zoarium is ramose; the branches are straight and very thin, about 1·0 mm. in diameter; lateral branches, which are slightly thinner near their origin, are given off at very distant intervals. There are about 15 rows of zooecial apertures; the apertures are oval, 0·08 × 0·13 mm. in diameter, and they are arranged in regular longitudinal rows, separated by slight longitudinal ridges; and they are also arranged in diagonally intersecting series. There are 29 zooecia in each longitudinal row in 10 mm., the distance between the centres of successive apertures being 0·28 to 0·40 mm. The area behind each aperture, and bounded on each side by the longitudinal ridges, contains about eight tiny mesopore-like pits, arranged generally in three longitudinal rows, with three pits in each of the two outer rows and two in the median row. No acanthopores are developed.

The zooecia are short and diverge sharply from an imaginary axis along the centre of the branch; there is no central bundle of small tubes developed in this species. The cortical zone is about 0·08 mm. thick, and the zooecia, although they bend outwards more sharply in this zone, meet the surface obliquely.

The small dimensions of this form readily distinguish it from any species previously described from Australia; amongst the North American Lower Carboniferous forms this species most closely resembles *S. nicklesi* Ulrich (1890, 667), but it is, however, a coarser species than the American form and differs in the number and arrangement of its mesopore pits.

As well as this common species of *Streblotrypa*, fine ramose Rhabdomesontidae as well as ramose batostomellids are of fairly frequent occurrence in material collected from horizons on which Bryozoa are common in the Lower Burindi and Lower Kuttung of the northern Hunter River district; the specimens are, however, usually poorly preserved, so that only this one species belonging to this family is described here.

Family SULCORETEPORIDAE Bassler, 1935 (restricted).

Cystodictyonidae (pars), Ulrich, 1884, 34; Ulrich, 1890, 385; Sulcoreteporidae (pars), Bassler, 1935, 21.

"*Zoaria consisting of two or three layers of cells grown together back to back, forming thin foliate expansions or triangular branches. Primitive cells semi-cordate or obovate-acuminate in outline, arranged in longitudinal series between vertical double plates. Primitive apertures sub-circular, being somewhat truncated on the posterior side. As growth proceeds the aperture is drawn out shaft-like, forming a tubular vestibule, and the longitudinal plates become obsolete. Superficial aperture with peristome and more or less developed lunarium. Interspaces between zooecia and vestibules occupied by vesicular tissue, the vesicles more or less completely filled with a minutely perforated calcareous deposit near the surface. Margin of zoarium sharp or rounded, and like the basal portion, non-celluliferous.*" Ulrich, 1890, 385 (as Cystodictyonidae Ulrich).

Range: Devonian to Permian.

Ulrich (1884) originally proposed the family Cystodictyonidae to include the genera *Cystodictya*, *Coscinium*, *Glyptopora*, *Prismopora* and *Evactinopora*, and possibly *Rhinopora*, *Taeniopora* and *Scalaripora*.

Bassler in 1935 drew attention to the fact that *Cystodictya* Ulrich, 1882, is a synonym of *Sulcoretepora* d'Orbigny, 1849, and therefore proposed the new name Sulcoreteporidae for the family.

Bassler referred sixteen genera to this family: *Acrogenia*, *Ceramella*, *Coscinium*, *Dichotrypa*, *Evactinopora*, *Glyptopora*, *Goniocladia*, *Phractopora*, *Prismopora*, *Ptilocella*, *Ramipora*, *Scalaripora*, *Semiopora*, *Sulcoretepora*, *Taeniopora* and *Thamnotrypa*. It is here considered that revision of this grouping is necessary, and that many of these genera should be removed from this family and placed as a sub-family of the Fistuliporidae. The reasons for this are as follows:

Sulcoretepora is characterized by a specialized type of cryptostomatous internal structure. The name *Sulcoretepora* was proposed by d'Orbigny with a poor and very inaccurate description—"Cellules placées par lignes dans les sillons longitudinaux, et d'un seul côté de branches simples deprimées, striées en long du côté oppose aux cellules"; "*Flustra parallela* Phillips, Yorkshire, pl. 1, f. 47, 48" was selected as the type. Phillips's (1836) description of this species, which was accompanied by two small figures, is as follows: "Linear, longitudinally and deeply furrowed; cells in the furrows, in quincunx, their apertures oval, prominent; (side furrows without cells). It appears to have been a tubular or folded membrane; the number of rows of cells differs in different specimens. No sign of bifurcation." M'Coy (1845, 198), who referred to this form as "*Vincularia parallela*", gave a brief description, pointing out that zooecial apertures were developed on each side of the zoarium and that the margins of the zoarium were smooth and without pores; later, d'Orbigny, in proposing the new name *Sulcoretepora* for this species, failed to realize that the branches were bifoliate. The only more recent reference which adds any information as to the structure of this form has been made by Ulrich (1884, 36), who briefly described specimens from Kentucky which he believed were identical with Phillips's specimens, and which were considered by him to be congeneric with *Cystodictya ocellata* Ulrich, the genotype of *Cystodictya* Ulrich.

Cystodictya is characterized by its narrow, ribbon-like bifoliate branches, on the surface of which the zooecial apertures are arranged in, usually, regular longitudinal and diagonally intersecting series; lunaria are commonly developed. Internally the zooecia are tubular, at first lying parallel to the mesial lamina and then bending upwards sharply to meet the surface at almost a right angle; in tangential sections passing through the zoarium close to the mesial lamina the zooecial tubes are arranged "in longitudinal series between vertical plates, to one of which they are laterally attached, while the intervening spaces are occupied by irregularly shaped smaller cells" (Ulrich, 1884, 35). The zooecia in sections cut at this level are semi-cordate in outline; hemisepta are frequently developed; closer to the surface the vesicular tissue between the zooecia is gradually replaced by dense tissue, the interspaces appearing smooth and solid at the surface, sometimes with faint to prominent longitudinal ridges developed between the rows of apertures. The genotype has been figured by Ulrich (1882, Pl. viii, figs. 3, 3a; 1884, Pl. ii, figs. 3, 3a); the tangential section which he figures passes rather close to the surface and does not show the characteristic arrangement of the semi-cordate zooecia between longitudinal vertical plates as well as it is shown in the figures of other species of the genus given by Ulrich and in figures given by more recent workers (Moore, 1929, Pl. 18; McNair, 1937, Pls. x–xiii).

Although this specialized type of internal structure has not been figured in any specimens of *Sulcoretepora parallela* (Phillips) from the type locality in Yorkshire, Ulrich placed specimens which he considered conspecific with this form in *Cystodictya*, and the external appearance of the specimens figured by Phillips, with the zooecia situated in furrows between prominent longitudinal ridges, perhaps also reflects the presence of vertical plates between the rows of zooecia internally, such ridges being also developed strongly in other species, such as *Sulcoretepora bifidiplicata* McNair and *S. obliqua* McNair.

A similar type of internal structure has been shown to exist in some of the other genera referred to the Sulcoreteporidae—in *Dichotrypa* Ulrich, where the zoaria are broad bifoliate fronds, in *Taeniopora* Nicholson and *Semiopora* Hall, and possibly in *Ptilocella* Simpson and *Acrogenia* Hall, which are very similar in their external appearance to *Sulcoretepora* and are classified with it, but whose internal structure does not appear to have been adequately illustrated.

Ulrich's original definition (1884) of the family did not mention the semi-cordate shape of the zooecia or the presence between the rows of zooecia of vertical plates as structures characteristic of the family, though he did describe these at length under his description of the type genus (as *Cystodictya*). In the revised and fuller definition which he gave in 1890, and which is quoted above, these characters are given as typical of the family. As has been pointed out on a previous page, many of the genera previously referred to the Sulcoreteporidae lack the vertical plates between the rows of zooecia, and their zooecia are simple and tubular, not semi-cordate, and are without hemisepta; the classification of these genera has been discussed on a previous page (p. 7). It is here considered that the family Sulcoreteporidae should be restricted to the genera which show the specialized cryptostomatous internal structure of *Sulcoretepora*; the remaining genera should be removed to the Fistuliporidae, of which family they are here considered to form a separate sub-family, the Hexagonellinae.

Genus Dichotrypa Ulrich, 1889.

Dichotrypa Ulrich, 1889, 300; Ulrich, 1890, 386, 498.

Sulcoreteporidae with large thin bifoliate expansions, the surface with solid maculae; zooecia at first parallel to the mesial lamina, then bending upwards to the surface; lunaria more or less strongly developed; internal structure as in Sulcoretepora.

Genotype: *Dichotrypa foliata* Ulrich, 1890.

Range: Devonian to Mississippian.

Dichotrypa fragilis, n. sp. Pl. iv, fig. 2; Text-figs. 27, 28.

Holotype: F.42112A, Australian Museum Colln.

Horizon and locality: Burindi Series, near Barrington House, Williams River, Barrington Tops.

Zoarium a spreading bifoliate frond with long, elliptical, depressed maculae; zooecia short, with distinct lunaria, and separated by fine vesicular tissue, with vertical plates between the rows of zooecia.

The zoaria are spreading bifoliate fronds reaching a maximum size of about 3·5 × 2 cm.; they are about 0·55 mm. in their maximum thickness, and are extremely thin near the periphery. The zoaria appear to arise from a small base near the centre of each colony, above which the colony spreads out rapidly; in each specimen it is the upper surface of the colony which is exposed, but one specimen, the holotype, shows a small protuberance in the centre where the colony appears to have been crushed against the base beneath, and in each specimen the zooecia radiate from the centre of the colony. The surface is marked by long, elliptical, slightly depressed maculae, usually about 4 to 7 mm. long, though they may be shorter, and from 1 to 2 mm. in their greatest width; the zoarium was so thin in the position of the maculae that they now usually appear as elongate spaces, but the thin solid tissue of the maculae remains in one or two places.

The zooecial apertures are small, and they are usually indented slightly by lunaria; their measurements are: *a*, 0·22 to 0·24 mm.; *b*, 0·22 to 0·25 mm.; *c*, 0·08 mm.; *d*, 0·16 mm. The apertures are surrounded by high peristomes, highest on the side on which the lunarium is developed—this is usually the side closer to the centre of the zoarium; the lunaria are thin, and they occupy about one-third of the circumference of each zooecial tube, but unfortunately crushing of the zoarium has distorted many of the zooecial apertures. There are about 34 zooecia in 7 sq. mm.; they are arranged in more or less regular rows radiating from the centre of the zoarium. At the surface the interspaces between the zooecia are smooth and solid; unfortunately, slides made of this form did not satisfactorily show the internal structure—the zoarium was slightly recrystallized, and was also rather crushed; the internal structure is, however, shown well on slightly weathered surfaces of the zoarium; the zooecial tubes are short; they lie back to back on either side of the mesial lamina for a short distance, and then curve sharply upwards to meet the surface perpendicularly; they are arranged in rows (which radiate from the centre of the zoarium) between vertical plates, and close to the mesial lamina rather numerous small vesicles occur between and above the zooecia; as the surface is approached these are replaced by a very thin layer of dense tissue.

In the largest specimen, the holotype, the zoarium is practically flat, but in a second specimen (F.42112B, Australian Museum Colln.) the zoarium is thrown up into two broad, deep folds along one edge.

This species is referred with some hesitation to *Dichotrypa* as, although in essentials it possesses the characters of this genus, it is unlike described species of *Dichotrypa* in its very elongate maculae, which give it a marked superficial resemblance to species of *Ceramella* and to fragmentary specimens of *Glyptopora*. From *Glyptopora* it is distinguished by the form of its zoarium, since, although one of the zoaria is strongly folded along one edge, the specimens, despite their small size, appear to be almost complete, and there is no tendency to form a complex zoarium composed of a number of cup-shaped masses such as that found in *Glyptopora*. From *Ceramella* it is distinguished by the well-developed lunaria which are clearly shown in some of the zooecial tubes, and the internal structure appears to be rather different from that found in either *Ceramella* or *Glyptopora*. From *Coscinium* it is distinguished by possessing solid maculae instead of open fenestrae bordered by a narrow solid edge. It therefore seems more closely related to *Dichotrypa* than to any of these three genera, since the shape of the maculae, though it is occasionally persistent and characteristic of a generic group, is of far less importance than the differences from other genera mentioned above.

Ceramella casei McNair, 1937, from the Middle Devonian Traverse Group of Michigan, resembles this species in its general external appearance; it also is an extremely thin bifoliate expansion, with similar elongate maculae with small zooecial apertures separated by solid tissue at the surface, but with the zooecia separated by vesicular tissue close to the centre of the zoarium; it differs from *Dichotrypa fragilis*, however, in the details of its size and structure, including the absence of lunaria.

SUMMARY.

The Bryozoa described in this paper are collections from the Lower Carboniferous of Queensland and from the Lower and Upper Burindi Series and the Lower Kuttung Series (Lower Carboniferous) of New South Wales; these collections contained representatives of a number of genera common in the Lower Carboniferous of Europe and North America but not previously known to occur in rocks of this age in eastern Australia.

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EXPLANATION OF PLATES I-VI.

Plate i.

Fig. 1.—*Fenestrellina yarrolensis*, n. sp. Obverse surface of the holotype, × 10.

Fig. 2.—*Polypora sulcifera*, n. sp. Obverse surface of the holotype, × 10.

Figs. 3-6.—*Evactinopora irregularis*, n. sp. Holotype. 3. Part of the surface of one of the rays, showing the elongate depressed maculae and the zooecial apertures, some of these being indented by lunaria, × 10. 4. Upper edge of the zoarium, natural size. 5. Lateral view of the zoarium, natural size. 6. Base of the zoarium, natural size.

Plate ii.

Figs. 1-2.—*Archimedes regina*, n. sp. Holotype. 1. Zoarium, natural size. 2. Obverse surface of portion of the meshwork, × 10.

Figs. 3-6.—*Archimedes spiralis*, n. sp. Holotype. 3. One of the fractured rootlets, which repeatedly forked at its distal end, × 10. 4. Lower end of the shaft, showing the rapid increase in diameter of the shaft above the second volution, where the shaft is joined by a ring of rootlets, × 2·5. 5. The shaft, showing in direction of growth above the fracture between the sixth and seventh volutions, and the broken bases of the rootlets developed on the under side of the shaft below the fracture; the frond is broken off at the edge of the flange throughout the zoarium; natural size. 6. Surface of the zoarium at the level of the ninth volution, showing the fractured ends of the branches of the meshwork, the direction of the striae of the fibrous tissue of the shaft, and the overgrowth of the shaft tissue over the broken ends of the branches on the upper side of the shaft.

Plate iii.

Figs. 1-2.—*Fistulamina malmoensis*, n. sp. Holotype. 1. Part of the zoarium, × 2·5. 2. Surface, showing apertures with peristomes and strongly-developed lunaria, × 10.

Fig. 3.—*Penniretepora fragilis*, n. sp. Obverse surface of the holotype, × 10.

Figs. 4-5.—*Ramipora* (*Ramiporella*) *flexuosa*, n. sp. 4. Obverse surface of the holotype, × 10. 5. Spreading base of a zoarium (F5768F, Qd. Univ. Colln.) from which three branches arise, two of these branches being broken off just above the base, × 10.

Plate iv.

Fig. 1.—*Evactinopora trifoliata*, n. sp. Holotype, showing two of the three vertical rays, lightly attached at their bases to a *Spirifer*, natural size.

Fig. 2.—*Dichotrypa fragilis*, n. sp. Upper surface of the holotype (a), natural size.

Fig. 3.—*Streblotrypa parallela*, n. sp. Part of the holotype, × 10. Near the centre of the photograph the zooecial tubes can be seen diverging from a fine line down the centre of the zoarium.

Fig. 4.—*Fistulipora mirari*, n. sp. Weathered surface of the holotype, × 10.

Figs. 5-6.—*Fistulamina inornata*, n. sp. Holotype. 5. Zoarium × 2·5. 6. Part of the surface of the zoarium, × 10.

Plate v.

Fig. 1.—*Ramipora* (*Ramiporalia*) *bifurcata*, n. sp. Holotype, natural size.

Fig. 2.—*Goniocladia parva*, n. sp. Part of the holotype, × 10.

Figs. 3-5.—*Goniocladia laxa* (de Koninck). 3. Part of a large zoarium (5424, Sydney Univ. Colln.), natural size. 4. A small portion of this same specimen, showing the reverse surface of a branch and, where weathered, showing the zooecia and vesicles, × 10. 5. Obverse surface of another zoarium (5424B, Sydney Univ. Colln.), × 10.

Plate vi.

Figs. 1-2.—*Hemitrypa clarkei*, n. sp. 1. Part of the surface of the holotype, showing the fenestrate zoarium and in the upper left-hand corner part of the finer hexagonal meshwork of the superstructure which is developed above the obverse surface, × 10. 2. A similar view of a second specimen (6430B, Sydney Univ. Colln.), × 10.

Fig. 3.—*Fenestrellina acarinata*, n. sp. Holotype, × 10.

Fig. 4.—*Fenestrellina propinqua* (de Koninck). Neotype, × 10.

Fig. 5.—*Ptilopora konincki*, n. sp. Holotype, × 10.